MACHINERY

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Two Industries that Never Say "It Can't be Done"

By Alvan Macauley

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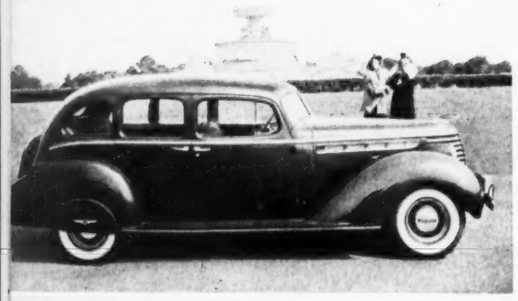
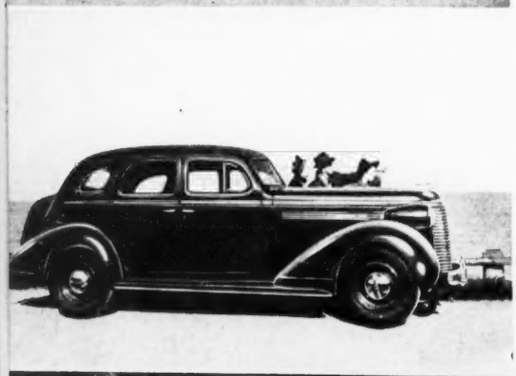
ONE of the reasons for the phenomenal growth of the automobile industry to its present great size has been its constant seeking for new and better methods and equipment with which to work in metals. The whole manufacturing world has profited through the manner in which the automobile industry has fostered the development of new machines and through the results that have been achieved by the machine tool industry.





THERE has long been fine cooperation between the American manufacturer of automobiles and the maker of machine tools in this country. It has been most helpful to both. It unquestionably will continue.

AS many persons know, my own company was one of the very first in our industry. It dates back to 1899. The chief difficulties of those who made the first Packards were encountered in procuring suitable materials, and in obtaining machines that could process these materials.

GEARS presented a major trouble. The ordinary steels then obtainable were not durable enough. Our manufacturing records show that a supply of armor plate steel was obtained, but it was so hard that the machines failed and broke in the gear making processes. Machine tool builders at first were reluctant to attempt the development of new machines that might handle the job.

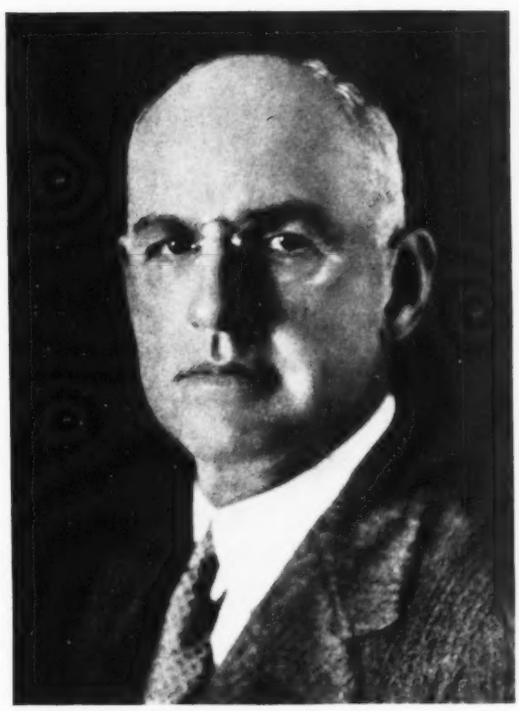
THIS situation forced the Packard company of the early days into an intensive development of the heat-treatment of steel. It was the only solution to the problem then. It permitted gears to be manufactured, and then hardened after the machining operations.

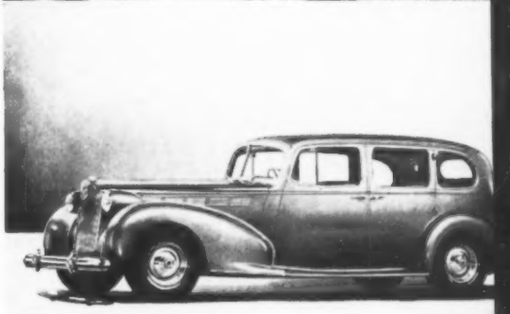
THE motor car industry in those days was insignificant as a customer both of the material suppliers and of the makers of machine tools. "It can't be done" was the answer it usually received to its urgent appeal for the development of new things that would help in making automobiles better, cheaper, and in greater numbers. As the industry grew in importance, however, this attitude changed. Both

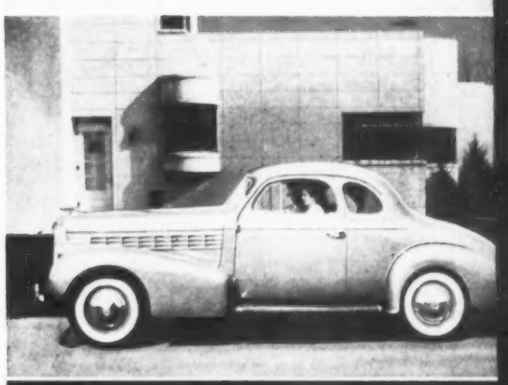
material suppliers and machine tool makers became imbued with a fine spirit of courage, initiative, and cooperation.

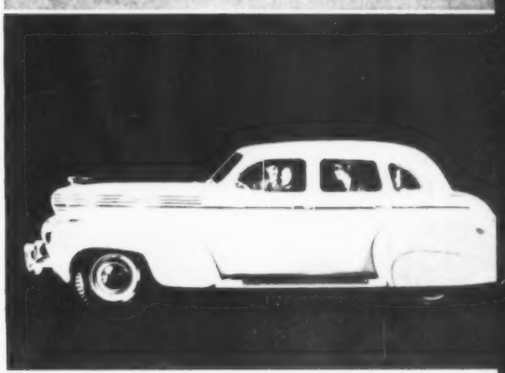
THE expression "It can't be done" is now practically banished when the machine tool builder and the automobile manufacturer get together to discuss new problems. Both, for years, have continuously been doing the things that "can't be done," and the whole world has marveled at it.

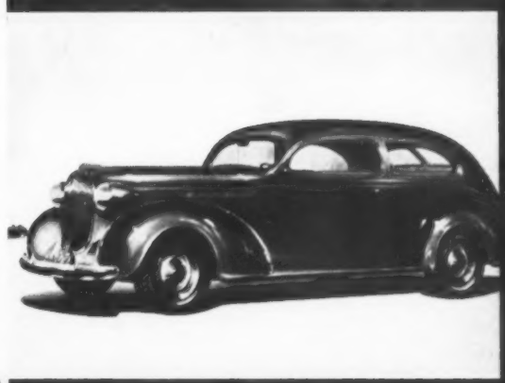
Kevan Macauley

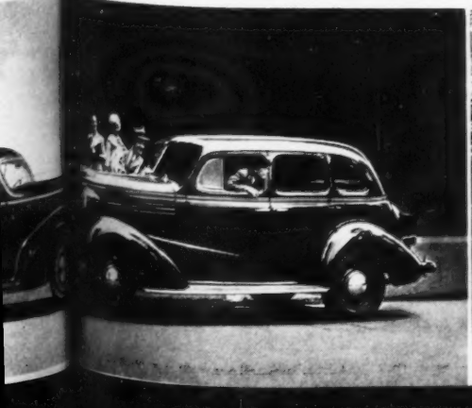


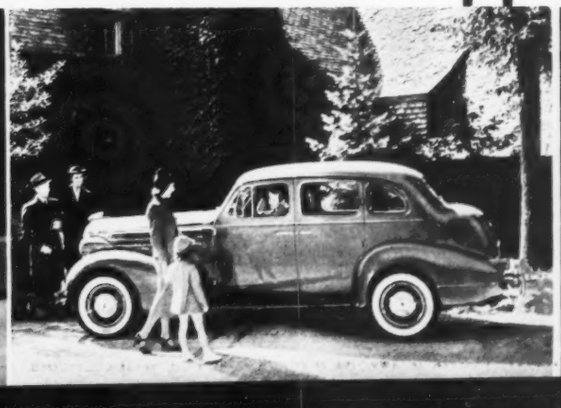












Heat-Treating Gears for

Gears for Both the Conventional and Automatic Transmissions of Buick Automobiles are Carburized in Atmosphere-Controlled Furnaces

By CHARLES O. HERB

GAS carburizing of transmission gears in the atmosphere-controlled furnace installed by the Buick Motor Co., at Flint, Mich., about two and one-half years ago proved so satisfactory that the concern has since installed a larger and improved furnace of the same type for this work and two additional furnaces for carburizing the gears used in the automatic transmissions. In all of these furnaces, which were built by Holcroft & Co., Detroit, Mich., the work passes through a long tunnel-like muffle, completely sealed from the combustion gases. Prepared gas that adds a slight amount of carbon to the steel of the gears fills the muffle from one end of the furnace to the other.

The furnace for the conventional transmission gears is about 50 feet long, and is divided into five different heating zones, the final zone being maintained at about 1525 degrees F. Micromax recording controllers insure uniform temperatures. The gears to be heat-treated are placed over vertical pegs on trays, as shown in Fig. 2, and pushed into the vestibule of the furnace through an outer door. An inner door seals the vestibule from the furnace proper whenever the outer door is open, thus guarding against the escape of heat and gas from the muffle. The pressure of the gas in the muffle is sufficient to prevent any infiltration of air through the furnace doors or of combustion gases at any point along the muffle.

After the outer door has been closed, the inner door is opened hydraulically in synchronism with a pusher-bar that moves the tray into the muffle and advances those ahead of it through the furnace. This pusher-bar operates every two and one-half minutes, thus continuously loading the furnace and pushing the work through to the discharge end. The pusher-bar extends the length of the furnace and has dogs on it, spaced 12 inches apart, which come in contact with the back edge of each tray. The gears are in this furnace approximately one and one-half hours before they reach the quenching tank. The racks are made from a nickel-chromium heat-resisting alloy.

The gas for the muffle is prepared by a generating unit, in which city gas and ordinary air are admitted into a cracking bottle and broken down

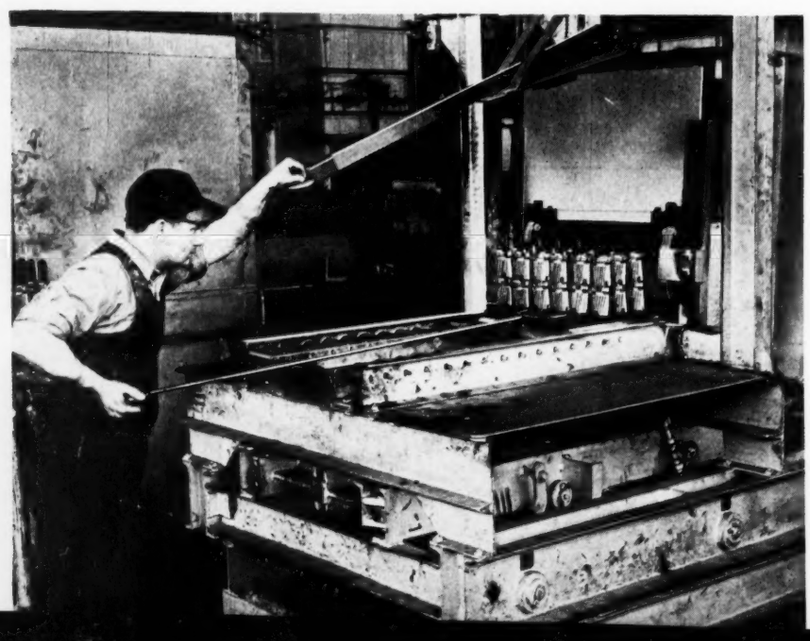


Fig. 1. (Above) Loading Buick Transmission Gears on a Vertical Conveyor which Carries Them to a Tempering Furnace and then Quenches Them in a Tank of Soluble Oil

Fig. 2. (Left) Pushing a Tray of Transmission Gear Sleeves into the Vestibule of the Atmosphere-controlled Furnace in which They are Carburized

Transmission Buick Cars

Conventional Transmission Gears are Quenched without Exposure to Room Atmosphere, while the Internal Gears for the Automatic Transmissions are Quenched in Gleason Presses

into carbon monoxide, carbon dioxide, nitrogen and water vapor. After passing through a condenser to remove the water vapor these gases are forced through a retort filled with charcoal, which changes the carbon dioxide into carbon monoxide. The gases delivered to the muffle consist principally of hydrogen, carbon monoxide, and nitrogen.

In passing through the gaseous atmosphere of the muffle, about 0.30 per cent carbon is added to the steel of the gear surfaces, resulting in a total carbon content of about 0.80 per cent on the surfaces, these transmission gears being made of SAE-3145 nickel-chromium steel. The gears have a hardness of from 58 to 60 Rockwell C after being quenched; the depth of case is about 0.006 inch.

Quenching occurs automatically when the gears reach the end of the muffle, where there is a "lowerator" which lowers the trays of work into a quenching tank beneath the furnace. The trays are carried down through a sealed chute, so that they remain in the controlled atmosphere of the muffle until they are submerged in oil. A transfer mechanism pushes the trays through the quenching tank, after which an elevator raises them to a short roller conveyor leading to a washing machine (Fig. 4).

As the gears come from the washing machine, they are hung individually on the racks of the vertical conveyor system seen in Fig. 1 and in the background of Fig. 4, which carries them upward through a gas-fired tempering furnace operated at 450 degrees F. The gears are in this furnace approximately one and one-half hours, the conveyor then carrying them to a quenching tank of soluble oil. At the end of this operation, the gears have a hardness of 52 to 55 Rockwell C.

The automatic transmission main shaft constitutes an exceptionally good example of high-grade heat-treating. This part, which may be seen in the straightening machine in Fig. 3, is about 10 1/2 inches long over all and has a 1/4-inch hole extending its full length. The part has two keyways at right angles to each other that must be straight within 0.001 inch, and four oil-holes at each end, which further complicates the heat-treating problem. The depth of case in the hole and on the external surfaces must be approximately 0.005

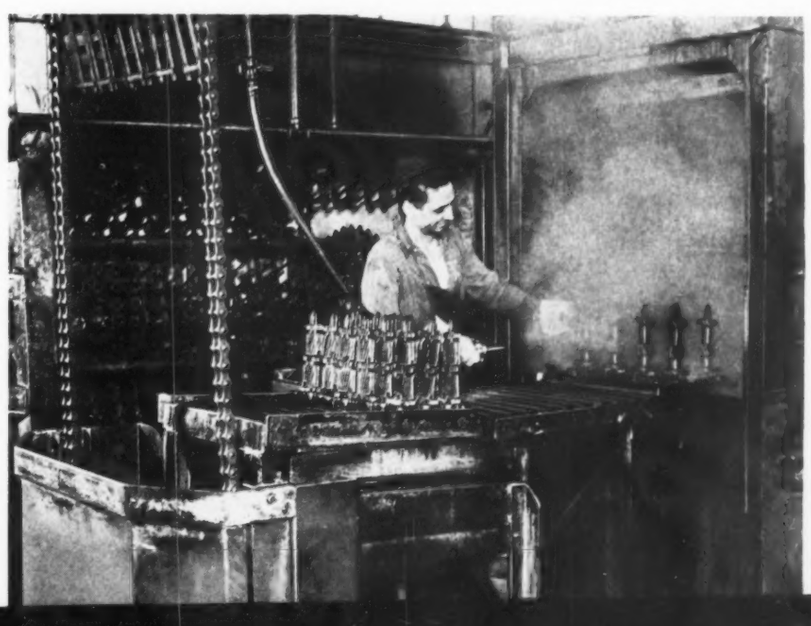


Fig. 3. (Above) Checking an Automatic Transmission Main Shaft for Straightness after Hardening and Correcting Inaccuracies with Part Held in Inspection Fixture

Fig. 4 (Right) The Transmission Gears are Lifted from the Quenching Tank by Means of an Elevator and then Pass Immediately into a Washing Machine

Fig. 5. Loading End of the Atmosphere-controlled Furnace that is Used for Carburizing Automatic Transmission Gears, this Furnace being Constructed with Two Muffles

inch, and at the end of the tempering operation, the piece must be straight for its full length within 0.002 inch. It is straightened after hardening to correct warpage, because the toughness of the part prevents much straightening after tempering. Such an operation is shown in Fig. 3.

Upon the completion of the tempering operation, this part is again checked in a fixture equipped with three dial indicators that determine the straightness of the part, the roundness of several surfaces, and the concentricity of the gear pitch diameter. Small inaccuracies are then corrected in an arbor press after the gear has been heated with a torch.

The internal gears for the automatic transmission are of such a thin cross-section that they must be handled somewhat differently from the gears for the main transmission. The furnace used is of the same general type, except that it is constructed with two tunnel-like muffles, about one foot square, through which the parts pass in a controlled atmosphere. The parts are laid on trays, as seen in Fig. 5, and are passed into the furnace through a vestibule, as previously described.

The gears are automatically advanced through this furnace by means of pusher-bars which operate only against the last trays in the lines. The trays are moved intermittently to another vestibule at the far end of the furnace, from which they are removed by the operator seen in Fig. 6, and quenched in Gleason presses. This furnace is about 25 feet long over all, and is also operated at 1525 degrees F. The parts remain in the furnace about one and one-half hours. Two muffles are provided in order to prevent any long exposure of the heated gears to the room atmosphere before quenching.

Gleason quenching presses are used in order to prevent distortion of the gears due to their thin sections. A different press is provided for each of the three gears handled by the furnace. Each press is equipped with dies to suit the particular gear being handled. In the case of two of the gears, one half of the die is mounted on a pedestal plate having grooves in it that radiate from the center to the outside, as seen in Fig. 7, while the other half is attached to an air-actuated ram.

After the gear has been placed over the lower half of the die, the head of the machine comes down and clamps the gear between the two halves. At the same time, a tapered mandrel on the head enters a hole in the center of the lower half of the die and expands sliding members outward to hold the internal gear concentric and maintain the proper diameter. The die and work are then completely submerged in oil. The oil flows through the grooves in the pedestal plate, through the die and around the work in such a manner that the thin

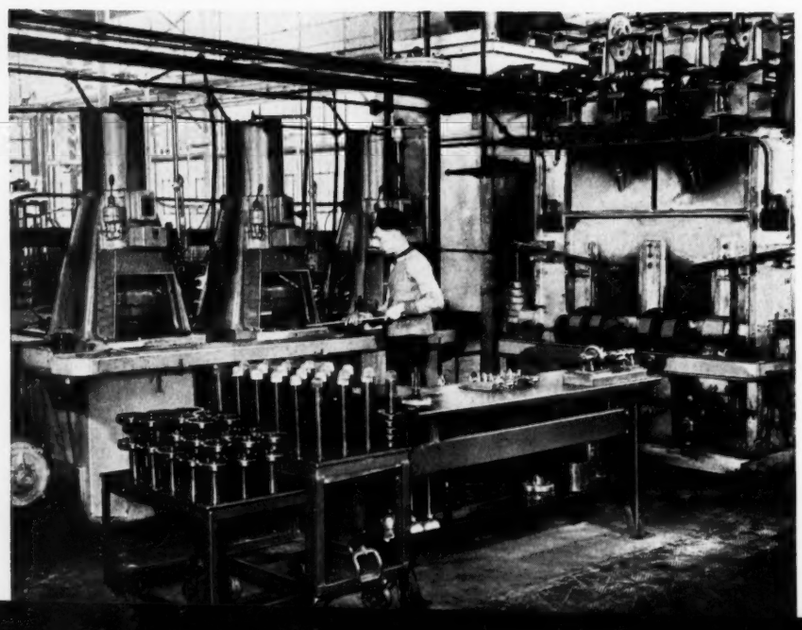


Fig. 6. Discharge End of the Furnace Used for Carburizing the Automatic Transmission Gears, the Battery of Three Gleason Quenching Presses and the Inspection Table

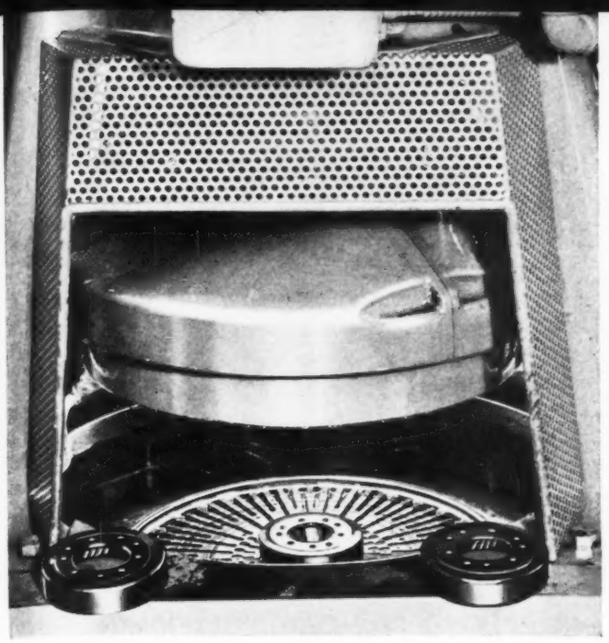


Fig. 7. Gleason Quenching Press Equipped with Dies that Prevent Distortion of Thin Gear Sections

Fig. 8. Quenching Press Used for Front Unit Drive Gear, which Has a Shank that Enters a Hole in the Die

and thick sections of the gear are cooled evenly. Although the work is so held as to insure straightness, there is provision for free contraction.

The press seen in Fig. 8 handles the front unit drive part, which has a shank, the bottom half of the die being made to receive the shank. The upper half of the die is expanded to maintain the desired gear diameter when the dies are closed. Oil is forced up through holes in the pedestal and in the gear when the die and the work are submerged, and out through the top of the head.

The two internal gears of the automatic transmission that do not have shanks are submerged for approximately three-quarters of a minute, while the front unit drive gear is submerged for one minute. The quenching oil is held at a temperature of from 90 to 110 degrees F., which has been found to insure free action of the dies as well as a high quality of work and to obviate die growth.

At the end of this operation, the parts have a hardness of about 58 Rockwell C, and the case is approximately 0.006 inch thick. These gears are made from S A E-4640 molybdenum steel. Immediately after being hardened, the automatic transmission gears are inspected in the fixtures seen in Fig. 9. The front unit drive gear is checked for expansion or contraction and accuracy of the pitch diameter by inserting two ball-tipped plungers between the helical teeth on the opposite sides of the gear ring. The limits are plus or minus 0.005 inch. This gear is also checked for straightness of the driving face and concentricity of the rim periphery. For this operation, the gear is held between the centers of the fixture seen at the left, and two dial indicators are used. The drive face must be flat within 0.006 inch, and the outside diameter must be round within 0.003 inch. The other two automatic transmission gears are checked by the fixtures at the front of the table for pitch diameter, roundness, and flatness. At the end of this inspection, the automatic transmission gears are tempered in the same furnace as the conventional transmission gears. After being tempered, they have a hardness of about 52 to 55 Rockwell C.

Fig. 9. Three Inspection Fixtures Used for Checking the Accuracy of the Automatic Transmission Gears after They have been Hardened and before They are Tempered

High-Grade Forging Practice

Some Outstanding Operations in One of the Largest Plants Engaged in the Production of Forgings for the Automotive Industry

THE automobile industry, through its demand for forgings of maximum strength without undue weight, and its constant efforts to attain that objective, exerted an important influence in the development of the present highly perfected forging equipment and methods. Haphazard forging has not been tolerated since metallurgical research brought out the vital fact that the strength and dependability of forged working parts are contingent upon the internal fibers of the steel following external contours without bends, buckles, or twists. The automotive industry, as a general rule, demands that forgings be produced with the best fiber flow-line characteristics obtainable. The forgings are usually cut in two and then carefully examined by micro-etching to determine the nature of the flow-lines.

Research has brought out additional facts of great value in actual forging practice, including the importance of holding the flash to a minimum, so that the tough outer fibers of the billet will be retained in the forging. Hammers, forging machines, dies, and furnaces have been improved in design and increased in capacity through definite knowledge as to what actually happens in forging operations.

One of the outstanding forging plants in the automotive industry is the Dodge Forge Plant in Detroit, which produces approximately 100 different parts used on the various cars manufactured by the Chrysler Corporation. The operations here described represent the practice followed in that plant.

Ring gears for all passenger cars made by the Chrysler Corporation are produced by upsetting in a 6-inch forging machine, built by the National Machinery Co. The carbon-molybdenum stock is received in the form of 4-inch square bars, 10 to 12 feet in length. These bars are heated to about 2100

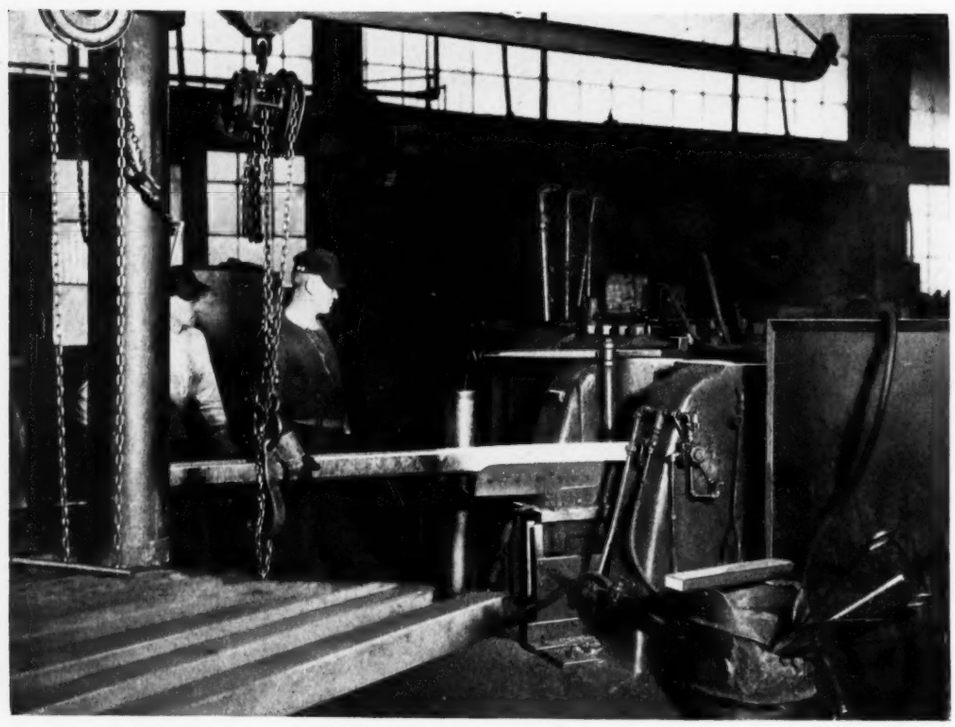


Fig. 1. Forging Automobile Ring Gears in a Heading Machine with Minimum Waste. Bars from 10 to 12 Feet Long Produce from Forty to Forty-four Gear Blanks

at the Dodge Plant

One Hundred Different Kinds of Parts are Forged in This Shop for the Various Automobiles Produced by the Chrysler Corporation

degrees F. in an oil-fired furnace and transferred to the adjoining forging machine by means of a hand hoist suspended from the boom of a jib crane, as illustrated in Fig. 1.

For the first step in the operation, the front end of the bar stock is placed in the lower cavity of a two-cavity die, with the stock supported on a short roller conveyor mounted at the front of the machine on an air cylinder. In Fig. 1, the conveyor is shown in alignment with the bottom die impression. When the machine is actuated, the front end of the stock is headed to a diameter of about 7 3/4 inches. After the dies have opened, at the end of this step in the operation, the air piston is actuated to raise the stock into line with the upper cavity. In the second operation, a 4 3/4-inch hole is pierced through the headed end of the stock by means of a punch, which both forms the hole and shears the gear blank from the bar. From forty to forty-four gear blanks are produced from one bar.

The gear blanks fall from the dies into a chute which leads to a pit at one side of the machine. Here they roll into a large skid basket which is readily lifted, when filled, by means of a crane and transferred to tumbling barrels. The heading machine produces, on an average, 210 blanks an hour. In addition to high production, this method of forging ring gears results in fiber flow-lines running from the periphery to the inside all around the gear, along the same lines as the gear teeth to be cut, and practically eliminates scrap.

In the barrel tumbling operation, the ring gears are rolled in steel shot to remove all scale. They are then reheated to about 2100 degrees F., and finish-forged to a diameter of 8 1/2 inches under an Erie board drop-hammer of 4000 pounds capacity. After the flash from this operation has been trimmed off in a power press while the forging is still hot, the gear blank is dipped in water to re-

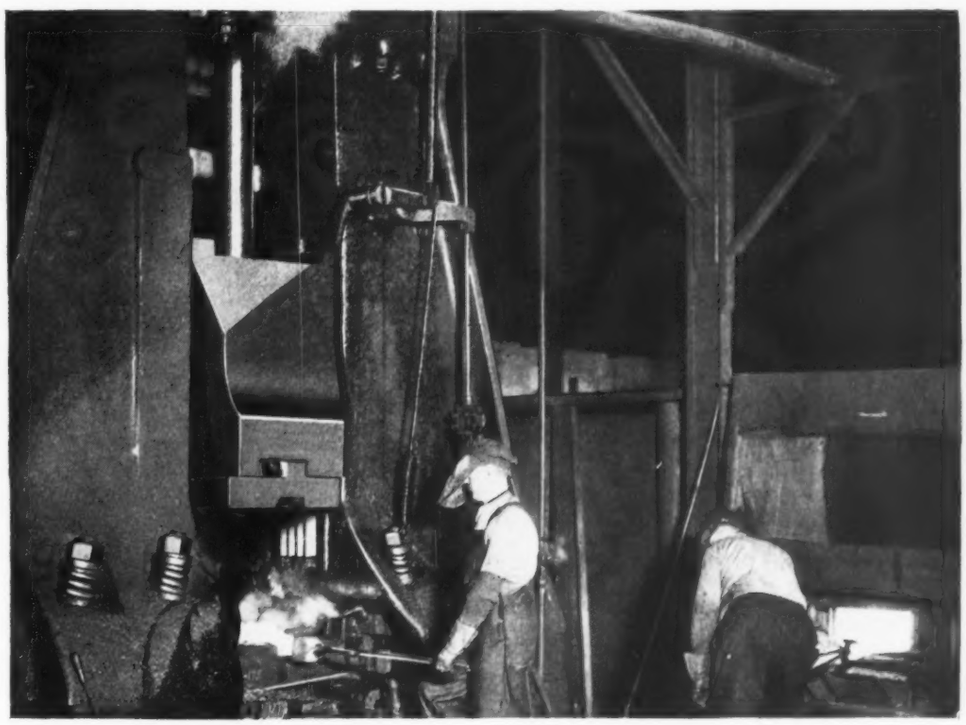
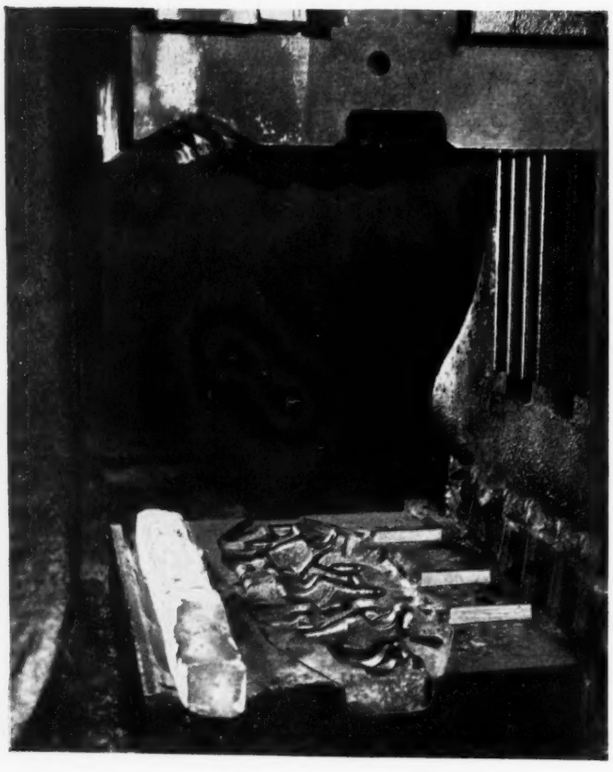


Fig. 2. Crankshafts are Forged under a 12,000-pound Steam Hammer from Billets 32 1/2 Inches Long, Rolled at the Mill to an Irregular Contour on Two Sides

Fig. 3. A Crankshaft for a Dodge Automobile and Specially Rolled Billet from which it was Forged

Fig. 4. Close-up View of the Hammer Dies which Block and Forge Crankshafts, with Billet Lying in the "Blocker" Impression



move free scale, and then a one-stroke restriking operation is performed in another power press.

Crankshafts for Plymouth and Dodge automobiles are forged by the Erie 12,000-pound steam hammer illustrated in Fig. 2. They are produced from billets 32 1/2 inches long which have been rolled on two of the four sides, as seen in Fig. 3, to an irregular contour that enables the crankshaft forging to be produced with minimum flash. The over-all length of the finished forging is 29 1/4 inches; the extra stock provides a hold for the tongs used by the forge man. The greatest width on the rough bar is 4 5/8 inches, and the smallest 3 1/2 inches, while the maximum diameter across the crankshaft is 6 3/4 inches, and the minimum diameter of the bearings 2 1/2 inches. The crankshaft billet weighs 112 pounds, and the weight of the crankshaft forging is about 84 pounds.

In this forging operation, the heated billet is first "blocked" in the impression on the left-hand side of the dies seen in Fig. 4, about three blows usually being struck. Then the forging is transferred to the second set of impressions and hammered into shape with ten or twelve blows. Steam ejected from eight jets along the sides of the bottom die keep the impressions free from scale. About 50 crankshafts can be forged hourly under one of these hammers.

Immediately after the forging operation, while the crankshaft is still at a high temperature, the flash is trimmed off in the dies of the power press shown in Fig. 6, and the tong hold is also sheared off. The flywheel flange is then upset on one end of the crankshaft in a forging machine, after which the crankshaft goes to a restriking press for sizing

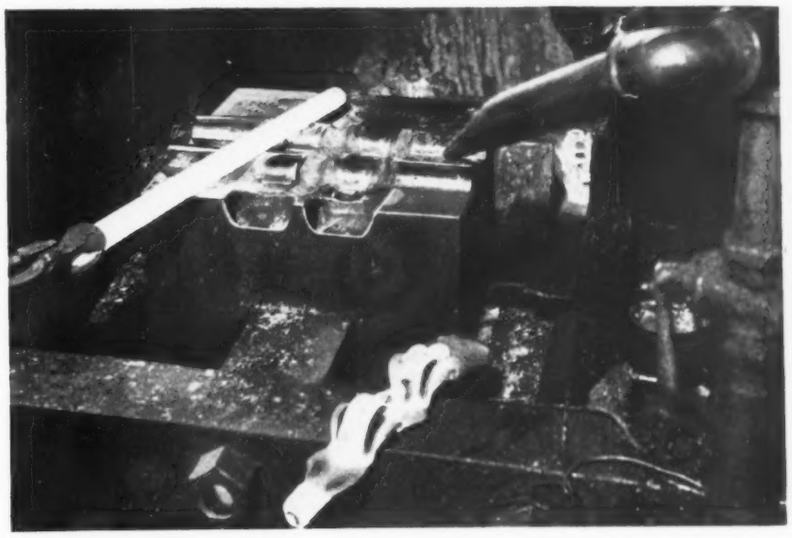


Fig. 5. Connecting-rod Caps are Forged Two at a Time from 1-inch Round Bars of High-manganese Steel

and straightening. A 600-ton press is used for the restriking operation.

All dies are made so that they can be refinished several times as the impressions become worn. For example, the crankshaft dies are made sufficiently thick so that they can be resunk three times, it being the practice to produce about 45,000 crankshafts with each set of dies.

Connecting-rod caps are forged two at a time from 1-inch round bars of high-manganese steel by means of the dies seen in Fig. 5, which are used in a Chambersburg 2000-pound board drop-hammer. Four caps, roughly 2 1/2 inches long by 1 1/4 inches wide by 1/2 inch thick, are produced from a bar 18 1/2 inches long. Four blows are struck with the stock in the two die impressions, and then two cap forgings are sheared off from the bar by placing the remaining shank between blades on the right-hand side of the dies near the back. For the forging of the connecting-rod caps, the stock is also heated to about 2100 degrees F. in an oil-fired furnace adjacent to the drop-hammer. About 3500 caps are forged in each hammer per eight-hour day. From 55,000 to 60,000 caps are forged for each refinishing of the dies, and they can be refinished five times.

This article has described only a few of the many forging operations in this shop, which has a total of about fifty hammers, ranging from 1600 to 12,000 pounds in capacity. The heading machines number about twenty-five, and they range in capacity from 1 1/2 to 6 inches. Additional operations performed in this shop, such as the forging of two connecting-rods from one specially rolled billet, will be described in a subsequent article.

Fig. 6. Immediately after the Forging Operation Shown in Fig. 2 the Crankshafts are Trimmed in This Power Press

Machining the Ford

The Machine Equipment Used for Finishing Pistons Having a Skirt Thickness of 0.030 to 0.035 Inch; the Specified Weight Must be Held within a Tolerance of One-Tenth of an Ounce

PRODUCTION men throughout the automotive industry are much interested in the cast-steel pistons used by the Ford Motor Co., because of the material from which they are made, their extremely thin sections, the close dimensional and weight tolerances specified, and the unusual methods employed in their manufacture. Through exceptional foundry practice, these pistons are produced with surfaces straight and sections of uniform thickness within the almost unbelievable tolerance of 0.005 inch.

After the pistons are cast, the physical properties of the metal are developed by heating the castings to 1650 degrees F., holding them at that temperature for one hour, air-cooling to 1200 degrees F., reheating to 1400 degrees F., holding at that temperature for an hour, cooling in a furnace to 1000 degrees F. within one hour, and then cooling in air. At the end of this heat-treatment, the hardness of the pistons is from 207 to 241 Brinell and the castings weigh 1 pound 14 ounces apiece.

A monorail conveyor brings the castings to the machine shop, where they are dumped in bins having chutes that lead to continuous broaching machines. These machines remove two gates from the dome end of the pistons. For this operation, the pistons are placed vertically in fixtures that carry them past stationary broaches arranged overhead, the pistons being automatically clamped before they reach the broaches and unclamped at the end of the operation.

Stock to a depth of 3/16 inch is cut away to remove the 1/2-inch diameter gates, the broach sections measuring 40 inches in over-all length. The average production is 1600 pieces an hour, and the broaches last for approximately 50,000 castings between regrinds.

The pistons fall from the broaching machines to an inclined conveyor that discharges them on a conveyor belt by which they are carried to a six-spindle, double-indexing machine of horizontal type. Here each piston is rough-turned its entire length, and the dome faced. Although this is a roughing operation, it is an extremely important

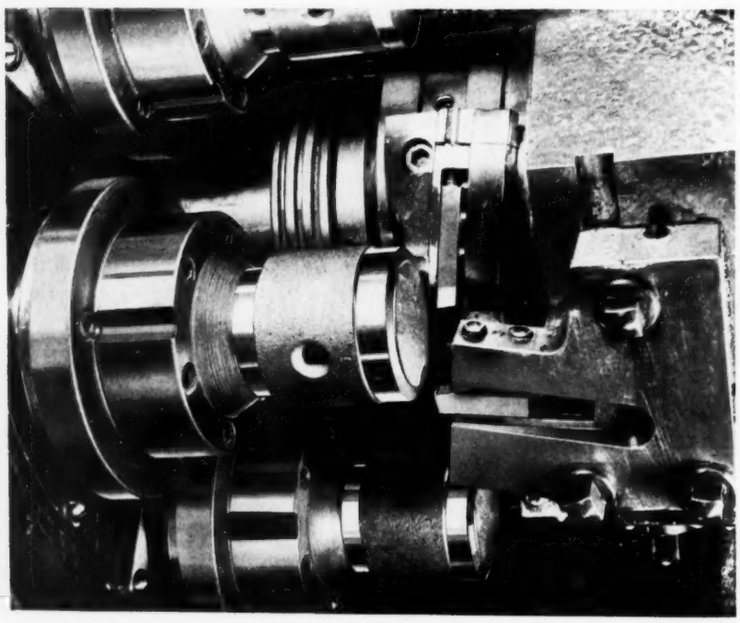


Fig. 1. Rough-turning and Facing Operation on Ford Pistons, in which the Original Wall Thickness Tolerance of 0.005 Inch Must be Maintained, Even with Unfinished Gripping Surface

Cast-Steel Pistons

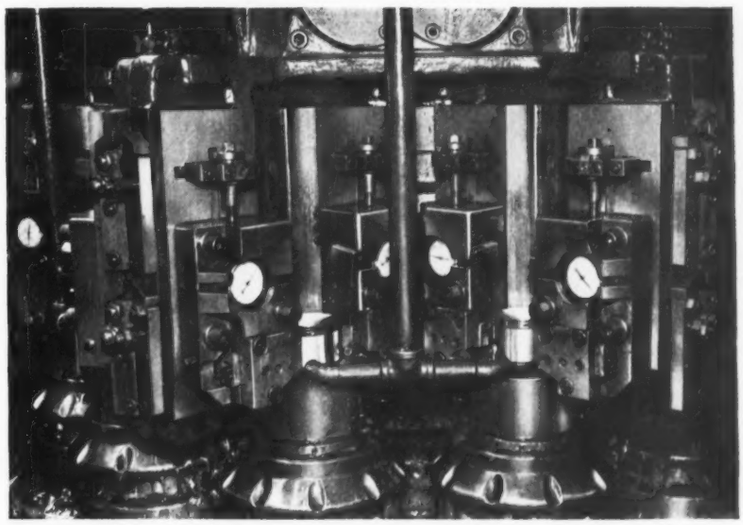


Fig. 2. The Ring Grooves are Machined within Extremely Close Limits by Tools Held in Hardened and Ground Blocks that are Located by Means of Dial Gages Permanently Fixed on the Machine

one, because the success of all the following operations depends upon the uniformity of the wall thickness when the pistons leave these roughing machines. The important requirement is that the total variation at the end of this operation between the unmachined inside of the skirt and the machined periphery must be not more than 0.005 inch.

Accuracy is obtained by gripping the pistons from the inside with two sets of four pins each, one set being applied immediately under the dome and the other near the skirt end. The pins of each chucking unit are expanded against the piston by the cam surfaces of a cylindrical plunger. The angle of the cams had to be carefully determined, in order that the pistons would be gripped securely without any distortion of their extremely thin walls. In loading each piston, care is taken to seat the inside of the dome on a solid locator.

Two turning cuts and two facing cuts are taken with single-point Stellite tools arranged as shown in Fig. 1. The tooling is duplicated at two double stations of the machine for taking identical cuts, and the third station is used for loading purposes. Stock to a depth of 0.06 inch is removed, the depth of cut in the second step of the operation being 0.015 to 0.030 inch. The pistons rotate at about 150 revolutions per minute, and the feed is 0.020 inch per revolution. The hourly production is 115 pistons per machine, and one man operates two machines.

The periphery of the pistons is next centerless-ground to within plus or minus 0.001 inch, about 0.015 inch of stock on the diameter being removed. The piston-pin holes are then drilled in a sixteen-spindle, vertical double-end continuous type of machine, after which the pistons reach a continuous vertical type machine equipped with single-point Stellite tools. Here each piston is weighed and then a cut is taken which serves the double purpose of finishing the dome and of bringing the weight of the piston to between 420 and 430 grams (14.82 and 15.17 ounces). The amount of metal that can be removed, however, is limited somewhat by the fact that the thickness of the *finished* dome must be between 0.070 and 0.080 inch.

As each piston reaches this machine on a conveyor, it is weighed on a scale and the dome thickness, which at this point in the operation must be between 0.095 and 0.100 inch, is determined by means of a dial gage. It is then placed in a chuck and a large dial on the machine, graduated similarly to the weighing scale, is set by the operator in accordance with the weight of the particular piston. One of these dials is provided at each of the machine stations. A locating spindle on the machine now descends and pushes the piston into the chuck an amount corresponding to the dial setting before the piston was clamped automatically, thus controlling the depth of facing cut.

The work starts revolving as it is indexed from

Fig. 3. The Eight Spindles of This Machine, which Drill Oil-holes around the Lower Ring Groove, are Located in an Inclined Plane for Loading Convenience and to Facilitate Observation

the loading position. A tool mounted on an arm then swings forward to face the predetermined amount of stock from the piston dome during its movement around the machine column. An interesting fact is that stock to a thickness of 0.001 inch across the dome weighs almost exactly 1 gram. Generally, from 10 to 20 grams, or 0.010 to 0.020 inch, of stock is faced from the piston dome in this operation. Underweight pistons must be scrapped at this point.

Line-reaming of the piston-pin holes follows, after which both the inside and outside ends of the piston-pin holes are chamfered. Then the grooves are turned in twelve-spindle continuous vertical type machines, equipped as shown in Fig. 2. Two sets of tungsten-carbide tools at each station take roughing and finishing cuts in forming the three grooves, one of them to a width of 0.094 inch, one to 0.0945 inch and the other to a width of 0.157 inch. The spindles are operated in pairs, the tools being mounted on cross-slides actuated by ring cams.

The limits on the groove widths are plus or minus 0.0005 inch, but in spite of this close tolerance, the average scrap due to defective grooves amounts to only 10 pistons in 30,000, an efficiency rating of 99.97 per cent. Approximately 10,000 pistons are grooved per grinding of the tools. When the finishing tools are worn, they are reground for use as roughing tools. A back clearance of 0.0005 inch eliminates dragging of the tools as they withdraw from the cut. These cutting tools are ground within

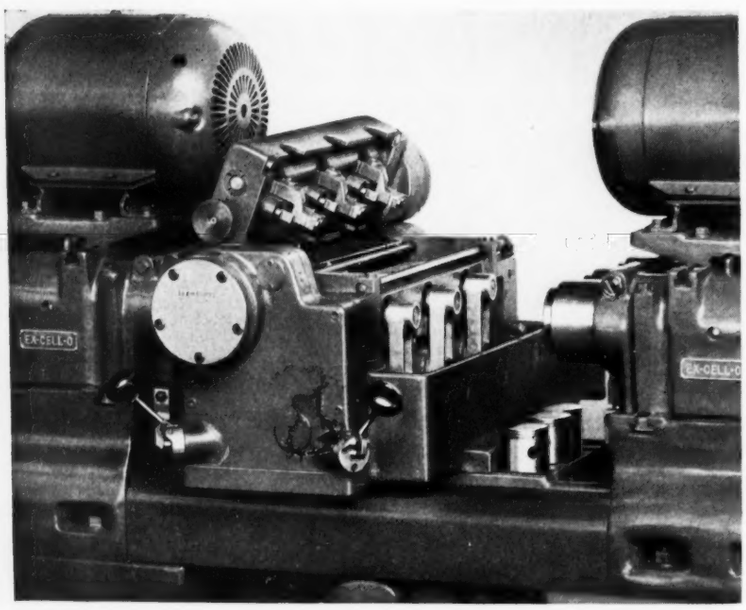


Fig. 4. Piston-pin Holes are Bored to Size within 0.0003 Inch by Tungsten-carbide Tools in Machines of the Precision Boring Type which Take Two Cuts Straight across Both Holes

plus or minus 0.0001 inch for width. The production per machine in this operation is 395 pistons an hour.

After each piston is inspected for porosity in a special type of machine, oil-holes are drilled in the piston-pin bosses by means of a special eight-station machine, which has two drill heads having two spindles each. The spindles of one head are arranged in a horizontal plane for drilling a hole in two pistons simultaneously, while the second head has the spindles arranged in a vertical plane for drilling the opposite holes in two pistons simultaneously at another station of the machine. This machine produces 625 pistons an hour.

Eight oil-holes are next drilled in the lower or oil-ring groove of the pistons by the machine shown in Fig. 3, which is arranged with all the drill heads in a 45-degree plane to facilitate loading and give an unobstructed view of the operation. The pistons are accurately located in both the compression ring grooves and by means of the piston-pin holes. All the drill heads feed inward radially at the same time, and return at a fast rate, the production in this case also being 625 pistons an hour.

A unique but unusually simple device is next employed for removing small burrs from the inner ends of the oil-holes just drilled. This consists of a high-speed spindle provided with a collar having two lugs. Loosely fitted to each lug is a small knurled part that flies outward, due to centrifugal force, when the spindle is revolved at high speed. The operator merely holds each piston over the

Fig. 5. An Operation which Controls the Weight of Each Piston within One-tenth of an Ounce—Correction is Made by Counterboring the Piston Skirt to a Predetermined Depth

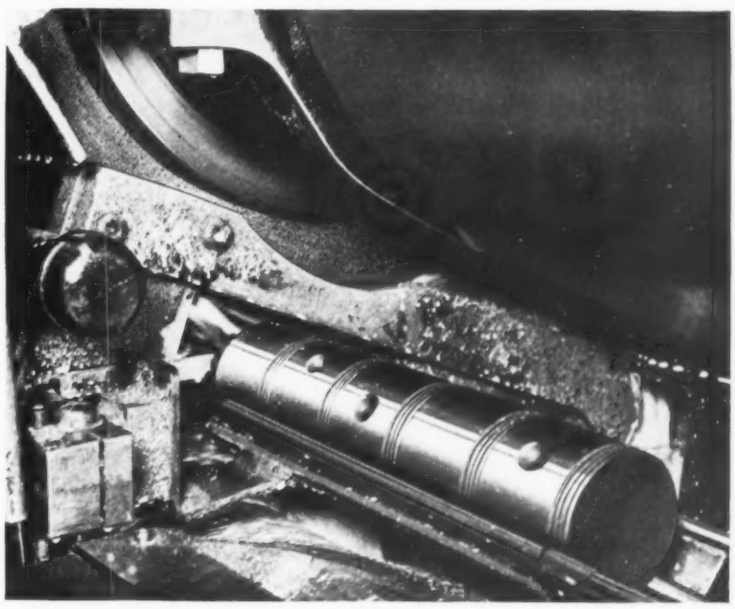


Fig. 6. Four Centerless Grinding Operations are Performed on the Skirt of Each Piston, as Only a Limited Amount of Stock can be Removed at a Time without Distorting the Thin Walls

spindle while it is stationary and then depresses an electric push-button with his knee to drive the spindle of the device at about 800 revolutions per minute. As the knurled "clappers" revolve, they break off all burrs from the inside end of the oil-holes.

Most of the machining operations on the pistons now having been completed, a correction for weight is again made in vertical rotary machines of the type shown in Fig. 5. When the pistons leave these machines, they must weigh between 337 and 340 grams (11.89 and 11.99 ounces), about 80 grams of metal having been removed since the previous weight-correcting operation. In the rotary machines, all surplus metal is counterbored from the open end of the skirt. For each gram of excess metal, the tool must be fed 0.007 inch. Each piston is again weighed, and a handwheel on the particular station of the machine in which the piston is to be loaded is then set to correspond with the scale reading. This setting governs the downward movement of the counterbore as the work and tool are indexed around the machine base.

For this operation each piston is seated in a split fixture on a pin that enters the piston-pin holes. From 1 to 8 grams (0.04 to 0.28 ounce) is generally removed to obtain the correct weight. The production from each of these machines is 650 pieces an hour.

The pistons are now passed to two centerless grinding machines, arranged in tandem, so that they are automatically advanced to the second machine as they leave the first. These machines grind off about 0.015 inch of stock on the diameter, this dimension being held to size within plus or minus 0.0005 inch. Each machine has six grinding wheels about 6 inches wide, and they produce 650 pistons an hour.

Precision boring machines are used for a final operation on the piston-pin holes. Fig. 4 shows the machine used in this operation, which is provided with two heads having three spindles each for machining three pistons at a time. With the forward movement of one spindle head, both piston-pin holes of each piston are rough-bored. Then when the second spindle head advances and the first has been withdrawn, they are finish-bored.

The pistons are accurately located in the fixture by plungers mounted on arms that can be swung into place for locating the pistons and then swung away after they have been securely clamped to permit the entry of the tools. Tungsten-carbide tools running at 1800 revolutions per minute, with a feed of 0.0042 inch per revolution, take the roughing cuts, while similar tools running at 2700 revolutions per minute, with a feed of 0.0023 inch per revolution, take the finishing cuts.

The piston-pin holes must be to size within plus or minus 0.0003 inch at the end of this operation and straight within 0.0001 inch across their entire length. One man tends two machines, the production being about 100 pistons an hour for each machine. Thirty-four of these machines are used.

After a wire ring retainer groove has been machined in the piston-pin holes, the pistons are again centerless-ground, from 0.002 to 0.0025 inch of stock being removed from the diameter. Relief is next ground on the lands between the ring grooves, as these lands must be 0.010 inch less in diameter than the skirt. In the same operation, which is performed in a special centerless grinding machine, a slight taper is ground on the upper portion of the skirt to slope from the lower groove.

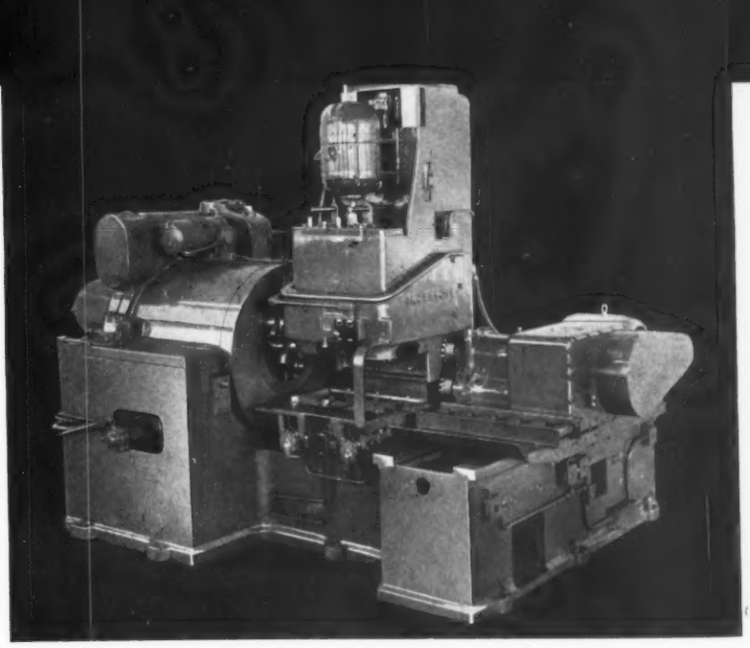
The light burr that remains around each land at the end of this operation is filed off as the pistons pass around a special rotary machine. The pistons are then once more centerless-ground in an operation which removes only about 0.0002 inch of stock per side, after which they must be to size within 0.0004 inch. Shadow gages are used to check this dimension. The pistons then pass through a cadmium-plating operation, after which all dimensions and the weight are inspected in an enclosed room that is maintained at a constant temperature.

▼ ▼ ▼

Increase in Nickel Consumption

The world's consumption of nickel in all forms during the first ten months of 1937, complete statistics for which have just become available, amounted to 201,000,000 pounds, an increase of 24 per cent over the corresponding figure for 1936. The consumption in the first ten months of 1929 was only 112,000,000 pounds.

The increase is accounted for by the larger output of products containing nickel, principally iron and steel; the introduction of nickel into new products; and the use of nickel in new industrial countries. Another significant factor in nickel consumption is the rapid development of manufacturing processes involving corrosive materials, where nickel, nickel alloys, Monel, stainless steel, and various alloy-clad steels provide industry with materials combining the requisite strength with the essential resistance to corrosion. Tank cars of nickel-clad steel are being used for transporting corrosive liquids, and tank ships are being built with holds of the same material.



"Custom Built" Milling Machine Equipped with Nine Spindles on Rotary, Horizontal, and Vertical Heads for Taking Ten Cuts on Automobile Cylinder Blocks

Combined Milling Cuts on Cylinder Blocks

TEN milling cuts are taken on automobile cylinder blocks by the "custom built" machine here shown, which was recently produced by the Ingersoll Milling Machine Co., Rockford, Ill. This machine is equipped with a rotary head, a horizontal traveling head, and a vertical traveling head. Milling cutters mounted on these heads, in one operation, rough and finish the front and rear ends of the cylinder blocks; mill both sides of the thrust bearings and the outside surface of the rear bearing; and mill an oil-slinger groove and two oil-pump bosses on the inside of the block. Twenty-six cylinder blocks are machined hourly.

The rotary head unit on the left-hand end of the machine carries three spindles, one for milling the oil-slinger groove and the rear bearing, one for rough-milling the rear end of the cylinder block, and one for finish-milling the rear end. This rotary head is fed through a complete revolution by an independent motor. It is mounted off center in a drum, and is so arranged that, by feeding the head through part of a revolution, the oil-slinger cutter and rear-bearing cutter are fed to the required depth of cut. The entire unit is adjusted hydraulically on ways toward the cylinder block, in order to bring the cutters that mill the rear end of the block to the proper depth of cut, as well as to position the oil-slinger and rear-bearing cutters.

The three spindles have independent in-and-out adjustment for setting the cutters, and the spindle on which the oil-slinger and rear-bearing cutters are mounted has an eccentric adjustment to suit the diameter of the cuts.

In operation, the rotary unit first moves into the cutting position against a positive stop, after which the drum feeds the oil-slinger and rear-bearing cutters to depth. The rotary head then turns through a complete revolution, and finally backs away from the work.

The horizontal head unit contains two spindles for rough-milling and one spindle for finish-milling the front end of the cylinder blocks. Each of the spindle quills can be adjusted in and out for setting the cutters to depth. This unit is also provided with an independent motor drive and a feed-box that is mounted on the end of the bed. The horizontal head is operated simultaneously with the rotary head, there being a rapid approach to the work, feed, and quick return.

The vertical unit travels on a housing that is integral with the holding fixture. This head also has three spindles, two for milling the sides of the thrust bearing and a third for milling the oil-pump pads. An in-and-out adjustment is provided for setting the cutters to depth by hand.

The vertical unit goes into action when the cutters of the rotary and horizontal heads have completed the roughing part of their cycles. The vertical head also has a quick approach to the work, feed, and quick return.

Except for loading and unloading, the operation is entirely automatic. The operator transfers each finished casting to a conveyor and slides the next cylinder block from the feeding conveyor into the fixture with the bottom side up. The block is clamped tightly in the fixture, after being located from the finished pan rail surface and two reamed dowel holes which engage fixed dowel-pins. The operator then pushes an electric switch button, which starts the three heads simultaneously.

Packard Bodies Welded by

The Most Spectacular of the New Equipment are the Huge Hydromatic Machines which Make 220 Spot-Welds in Less than Twenty Seconds

GREAT changes were made in the body shop of the Packard Motor Car Co., Detroit, Mich., for fabricating the all-steel bodies and turret tops adopted for the first time on the 1938 automobiles produced by this concern. The welding equipment used for previous cars was completely replaced by three huge machines of the Hydromatic type, about 175 portable hydraulically operated spot-welding guns, and a battery of fourteen arc-welding machines of latest design. The new equipment, including numerous welding fixtures, cost approximately $2,500,000.

Of this equipment, the Hydromatic machines which perform several hundred welds automatically within a matter of seconds are the most spectacular. These machines, which were built by the Progressive Welder Co., also of Detroit, are installed in a row for progressively welding the under-body assembly, which consists of the front and rear floor pans; rear seat pan; rear compartment floor pan; toe risers; side sills; cross-sill, seat, and door-pillar reinforcements; etc. Over twenty pieces in all are welded together by the three machines, which make a total of 558 welds. Two operators are required for each machine.

The first of the Hydromatic welding machines, Fig. 1, makes 220 spot-welds; the second, 224; and the third, 114. The operation is automatic after the machine has been loaded and the operators have depressed push-buttons on their respective sides of the machine. Each man must place both hands on buttons to start the operation, this interlocking control being provided to prevent accidents.

Welding is performed by means of cableless guns mounted on a vertically moving head, as shown in Fig. 2. There is a gun for each weld to be made. After the moving head has been lowered hydraulically to bring the guns into contact with the work, the guns are operated twelve at a time in rapid succession until the operation has been completed. Hydraulic pressure applied individually to each gun insures proper contact of the metal pieces to be welded before the electric current is applied. A hydraulic pressure switch starts the timing circuit, which is controlled by means of an easily adjusted Allen-Bradley repeating timer. Less than twenty seconds is required for the operation of all the guns on a machine. The machine head then rises automatically and the welded work is transported on rails to the next machine.

There are six transformers of 150 kilovolt-ampere rating on each machine, two spot-welds being made at a time through each transformer. These transformers are located beneath the lower electrode casting, which is mounted on a sturdy hard-

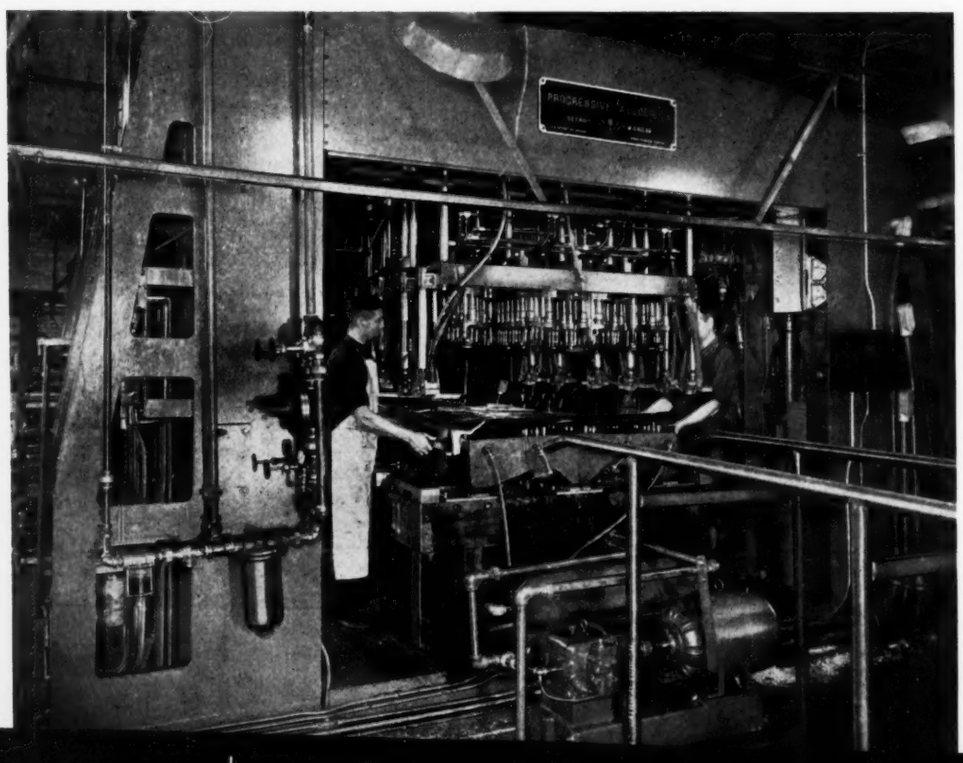


Fig. 1. One of Three Huge Hydromatic Welding Machines which Perform a Total of 558 Spot-welds on Packard Automobile Bodies

Completely New Equipment

wood base so as to eliminate induction losses from the transformers beneath. Welding current is transmitted to the upper electrode casting by means of floating copper pads that seat on bus-bars at the sides of the lower electrode casting. These current-conducting pads and bus-bars can be seen in Fig. 2. The lower electrode casting is provided with replaceable buttons beneath the welding guns, which are attached to the upper electrode casting. The welding guns, transformers, and electrode castings are all water-cooled. Hydraulic power for operating the head to which the upper electrode casting is attached is derived from an Oilgear unit.

These Hydromatic welding machines have a maximum capacity of sixty under-body assemblies per hour. They do not occupy any more space than the former equipment, which had a much lower production. The completed under-bodies have overall dimensions of approximately 11 feet 5 inches by 4 feet 4 inches.

The hydraulic portable welding guns were also supplied by the Progressive Welder Co. They are employed for a large variety of operations on the roof interior, window frames, door pillars, cowl, fenders, drip moldings, trunk, etc. Each gun has been designed to suit its particular application, but the transformer and hydraulic booster units are all of standard construction. At the same time, the gun fittings and electrodes can be changed as required from time to time by car model revisions.

The transformer booster, in most instances, is suspended from an overhead track and mounted on a swiveling housing, so that the welding gun can be readily applied at any point within a 12-foot radius without moving the unit. Generally speaking, the welding guns are of unusually light weight, so that they can be handled throughout a working day without fatigue. However, in some instances, a Thor balancer relieves the operator from the weight of the gun, electrical cables, and oil and water lines.

Pressures from 0 to 400 pounds are applied with these hydraulic guns to suit the different gages of metal welded and the nature of the work. This pressure insures that the two sheets of metal to be joined will be tight together before the welding current is applied. The pressure is applied and released through a finger-tip controlled valve. Most of the transformers on these portable units are of 50 kilovolt-ampere rating, although a few have a rating of 75 kilovolt-amperes.

The hydraulic welding guns are installed along conveyors, which carry the bodies through successive stages of fabrication and also on and around fixtures in which the important body parts are clamped for accurate location in welding operations. Fig. 3 shows an operation in which the roof and quarter panel of a body are being spot-welded by means of an expansion type of gun. With the electrode in contact with one of the metal sheets to be welded and the other end of the gun housing engaging a channel groove in the work-fixture, when the valve button is depressed, the gun is expanded lengthwise, so as to exert the required

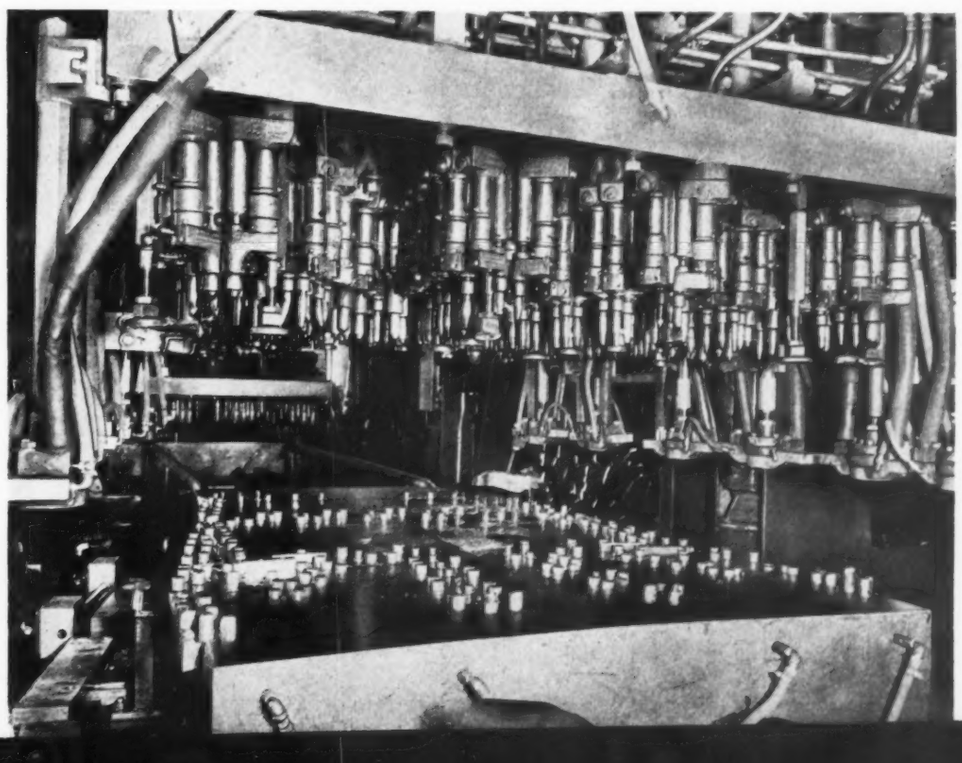


Fig. 2. The 220 Welding Guns of This Machine are Operated Twelve at a Time within a Period of Only Twenty Seconds

Fig. 3. Portable Spot-welding Gun which Applies Pressure on the Sheets being Welded through the Operation of a Hydraulic Piston

pressure on the sheets before the welding current is applied.

Fig. 4 shows the application of two pincher types of guns, in which one of the electrode-holders is hinged and forced toward the other when the hydraulic pressure is applied. Another pincher type gun is shown being used by the central operator in Fig. 5, while bar type guns are being applied on both sides of the fixture. The upper part of this fixture is a huge air-operated clamp, which is hinged at the back and swings upward about 90 degrees for convenience in loading.

Such metal pieces as the drain-gutter molding, rear window frame, and windshield-molding retainer are welded to the roof panel on the conveyor line illustrated in Fig. 6. The roof and the pieces to be welded to it are assembled in fixtures mounted on trucks that move around a large oval track. Each fixture is provided with hand-operated clamps for holding the various pieces to the roof panel until they have been spot-welded by means of overhead hydraulic portable guns. A feature of this operation is the use of 1/4-inch thick copper strips under the clamps. Welding is performed through these strips, with the result that the welds are unusually smooth and require little finishing.

While the roof panels are still in these fixtures, Mortex is spread all over the under side, and then sheet Waddex is laid on this surface and rolled so that it will adhere all over. There are twelve trucks and fixtures in this conveyor line.

Stationary fixtures are used for operations in which the quarter panels, lower panel, roof, side frames, floor-pan assembly, etc., are welded together. The various parts are placed in the fixtures and held securely against supports by means of air-operated clamps. Some of the welding guns are permanently fastened to these fixtures, while others are suspended from overhead. From these stationary fixtures, the bodies are transferred to a conveyor for oxy-acetylene welding the cowl panel to the roof and for a large number of spot-welding operations on such pieces as the window frames, seat assemblies, and trunk drain gutters.

Various joints that have been merely tack-welded in the floor assembly fixtures are next arc-welded as the bodies are carried through an air-conditioned passageway in which fourteen Westinghouse arc welders have been installed. Different brackets are also welded in place with this equipment. The passageway is heated in winter and cooled in summer for the comfort of the operators.

Fig. 4. Welding Cross-sills to the Under-body Assemblies by the Use of Hydraulically Operated Pincher Type Spot-welding Guns

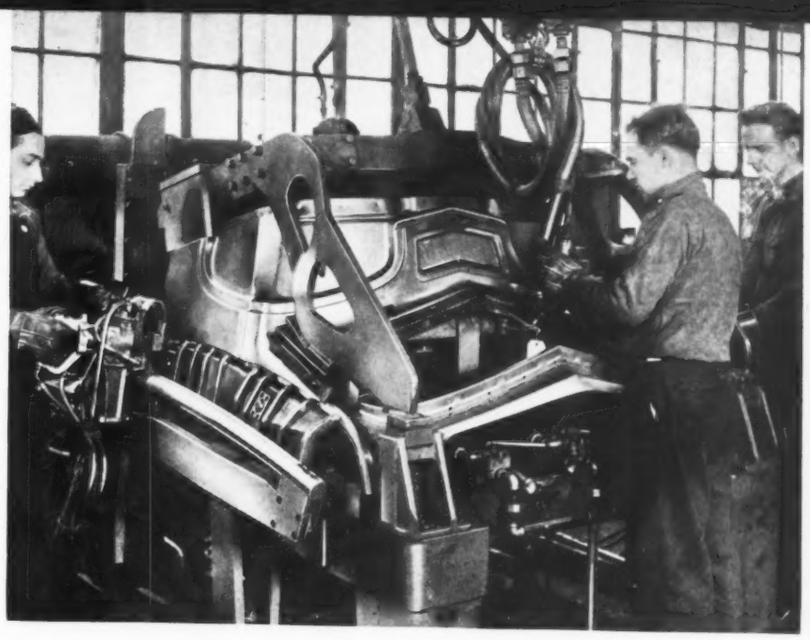


Fig. 5. Using a Hydraulic Pincher Type Welding Gun and Two Bar Type Guns; the Huge Overhead Clamp Swings up for Loading

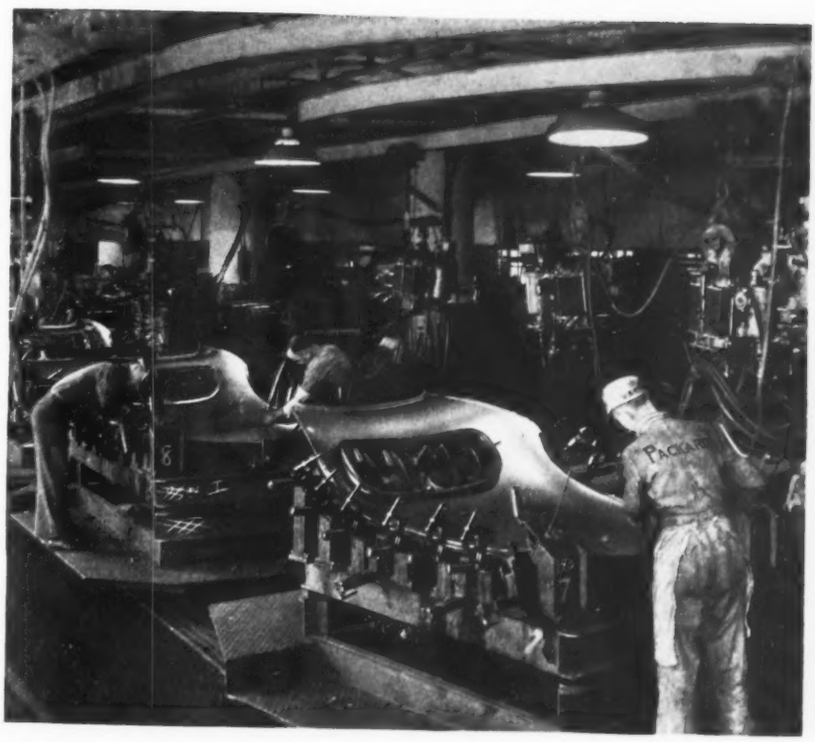


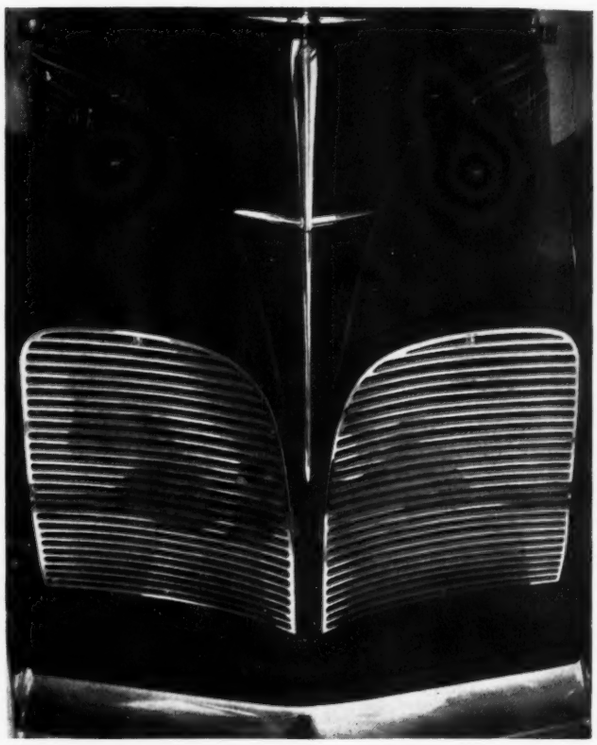
Fig. 6. Welding Operations on the Roof Panels are Performed with Portable Guns while the Panels Proceed Around a Conveyor Track

Fig. 7. Welder Using a Hydraulic Portable Welding Gun on the Inside of One of the Large Body Assembling Fixtures

How Die-Castings Reduce Costs

EVERY automotive engineer familiar with die-castings knows that they are used, in general, because they involve low cost in obtaining a given result. Much more is accomplished in many applications, however, than mere saving in cost, important as that is. The "given result" usually involves better appearance of the finished product, fewer parts, closer dimensions, better distribution of metal resulting in lighter weight, a smoother surface, lower tooling costs, lower assembly costs, and freedom from corrosion. All these advantages are gained with die-castings, and especially with those produced from zinc alloys, because of their low cost.

A few specific examples will serve to make these facts evident. A single simple die-casting forms the glove compartment door on the Olds instrument panel. Mounting bosses for a clock and for a lock are integral parts. Similar doors are sometimes stamped, but they require at least two and often more parts, and two or more separate dies, each, as a rule, costing more than the die-casting die. This also necessitates various assembly operations.



The extent to which die-castings are employed is indicated in Fig. 2, which shows seventy-six die-castings in zinc alloy used on 1938 Dodge cars. A large proportion of these parts could not be duplicated by any method at a cost comparable to die-castings. Some of them, such as certain of the grille parts and the long louvres, might be stamped, but not with the sharp lines and nicety of detail or with the close dimensions held in the

Fig. 1. (Above) The Front of the Lincoln-Zephyr Car is Enhanced in Appearance by Handsomely Plated Die-castings

Fig. 2. (Left) Seventy-six Zinc-alloy Die-castings Employed as Decorative and Structural Parts in the 1938 Dodge Car

and Improve Appearance

By
HERBERT CHASE

die-casting. In this case, stamping dies probably would cost four or more times as much as die-casting dies, and the parts would involve assembly operations not needed with the die-casting. The horn ring might also be built up from stamped parts and wire, but this, besides much higher die costs, would involve welding or other assembly operations. For carburetors, fuel pumps, windshield wipers, horns, and hardware, die-castings possess obvious advantages, including low cost. They are, however, often supplemented by screw machine products, some of which are employed as inserts in the die-castings.

Front end appearance, a paramount factor in modern car styling, has become extraordinarily important from the sales point of view. It accounts, in part, for example, for marked sales increases of certain cars. The die-castings used to gain these results are relatively low in cost, but they add finishing touches in a non-rusting white metal, and are extremely important in gaining the desired appearance.

Other striking results are obtained with large one-piece grilles, as on the Olds eight, for example. In this instance, the grille dominates the front end, and its sharp, clean-cut lines are in marked contrast to the stamped louvre openings in the apron at each side. Die-cast grilles sometimes add weight, but in this case, the complete grille weighs only 13 pounds, or less than half that of some other grilles. Its cost is also considerably less. This grille could not be reproduced in stamped form with equal appearance, but even if it were approximated, dies for stamping it probably would cost four or more times as much as the die-casting dies, and, with limited production, would result in a far higher cost per grille.

So far as front appearance is concerned, the chief difference between the 1938 standard and deluxe Ford models is in the use of a 3 1/2-pound die-cast center bar in the grilles of the deluxe type. Although the standard model is considerably lower in price than the deluxe type, the latter is reported outselling the former in a ratio of about 8 to 1. Just how much of this is a result of the better front appearance of the deluxe job it is not possible to say, but it is certainly an important factor, and one to which the smartly designed and well finished die-casting adds a great deal.

Nearly all deluxe model cars today are equipped with highly attractive steering wheels having a die-cast hub, stainless-steel spokes, and light colored plastic rim. The die-cast hub is employed because of its excellent finish (it is usually plated) and because the metal can be disposed exactly as required to give the desired results. One maker reports that such a hub has twice the torsional strength of the hub formerly used. It also involves economy in manufacture, requiring practically no machining work. Similar economies are attained in die-casting the shifter lever used on the new Olds and Buick automatic transmission, which is an irregular-shaped part having a hub and a lever partly tubular and partly of C-shaped section.

Fig. 3. An Interior View of the Packard Car, Showing Some of the Many Die-cast Parts

Producing the Chevrolet

The Adoption of a Part Entirely New in Automobile Design Necessitated the Development of Some Unusual Operations

By CHARLES O. HERB

A RADICAL departure in clutch design was made in the 1938 Chevrolet passenger cars and trucks with the adoption of a one-piece diaphragm spring for holding the clutch in engagement, instead of the nine coil springs that were used in former clutches, which followed conventional design. The diaphragm spring has the shape of a disk washer, 9 inches in diameter, with eighteen integral tapered fingers separated by slots extending from small oval holes near the rim to a central hole.

In a car, when the clutch is engaged, the diaphragm spring is virtually flat under compression and the entire rim of the spring bears against the pressure plate, the pressure thus being uniformly distributed. When the pedal is depressed to release the clutch, the spring fingers are flexed in the direction opposite to that in which they are inclined before the spring is assembled. The spring is thus dished sufficiently to cause the rim to move away from the pressure plate. The spring exerts a direct pressure of about 1100 pounds on the pressure plate, yet it can be released with a pressure on the pedal of 25 pounds. An advantage of this form of spring is that the amount of foot pressure required decreases during the pedal movement. The simplified design and the uniform application of pressure are other desirable features.

These diaphragm springs are made from pickled and oiled hot-rolled steel of S A E 1080 specification. The first operation consists of blanking a disk and piercing the central hole and the eighteen oval holes in a 250-ton inclined power press. Then slots are pierced from the oval holes to the central hole in a second press operation, to form the tapered fingers. Nine slots are cut with one stroke of the press; then as the ram ascends, the die is automatically indexed 20 degrees in the horizontal plane to position the spring blank for punching the remaining slots, on the next stroke of the press ram, between the slots that were punched on the first stroke.

The appearance of the spring blanks after this operation will be seen in Fig. 1, which illustrates a spring being loaded into an electric rotary furnace for heating prior to undergoing a flatten-

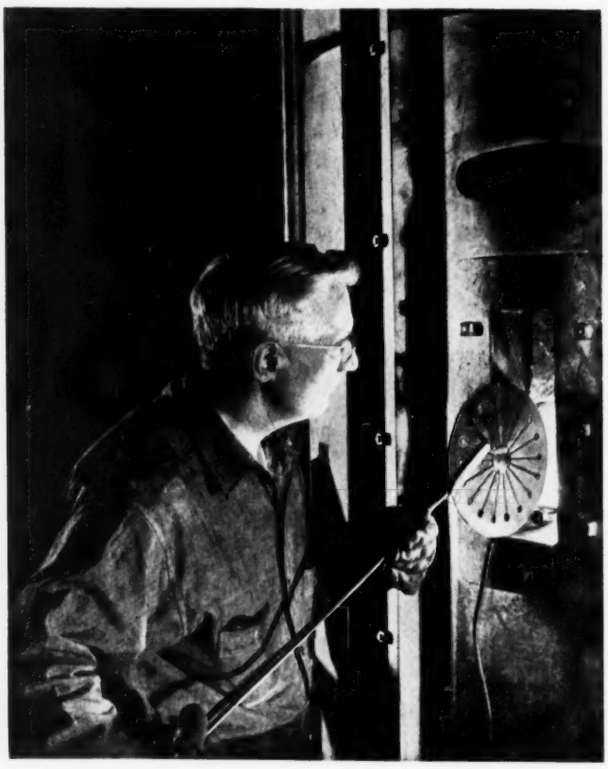


Fig. 1. Loading One of the Chevrolet Diaphragm Clutch Springs into an Electric Rotary Furnace for Heating prior to being Subjected to a Flattening Operation

Diaphragm Clutch Spring

Forming the Conical Spring by the Application of Hydraulic Pressure on the Heated Work, and Shot-Blasting to Increase the Strength, are Two Operations of Especial Interest

ing operation. This furnace is operated at a temperature of about 900 degrees F., and the blanks remain in the furnace for approximately one hour. They are discharged automatically through a chute and are then flattened between two dies on a 600-ton press. The dies of this press are preheated to guard against premature cooling of the spring blanks.

The springs are next ground, on both sides simultaneously, to a thickness of 0.106 inch, within limits of plus or minus 0.002 inch, by the double-disk grinding machine illustrated in Fig. 3. Only a slight amount of stock is removed in this operation, and it is for this reason, that the springs are previously flattened between dies. For the grinding operation, the springs are mounted in a holder that is slightly thinner than the required thickness of the springs. This holder carries each spring back and forth several times between the grinding disks. The spring spins in the holder during the performance of the operation, this effect being obtained by driving the grinding disks in opposite directions.

One of the most important operations in the manufacturing process then follows. This consists of compressing the metal around the entire circumference of the eighteen oval holes. The operation is performed in a 400-ton power press equipped with punches having pilots that enter the holes to prevent them from contracting when pressure is applied by a shoulder near the upper end of each pilot. The shoulder compresses the metal into a bevel edge completely around the hole. This operation strengthens the metal around the holes and eliminates the tendency of the spring to fracture from the holes to the rim when it is placed in service.

At the end of this operation, the thickness of the metal in the cross-section between the holes and the rim must be to the specified size within a tolerance of 0.003 inch. This thickness is determined by means of an Electrolimit gage, the springs being placed over a plug and revolved under a roller mounted on the gage plunger, so that a reading can be taken completely around them.

The springs are then hardened by heating in

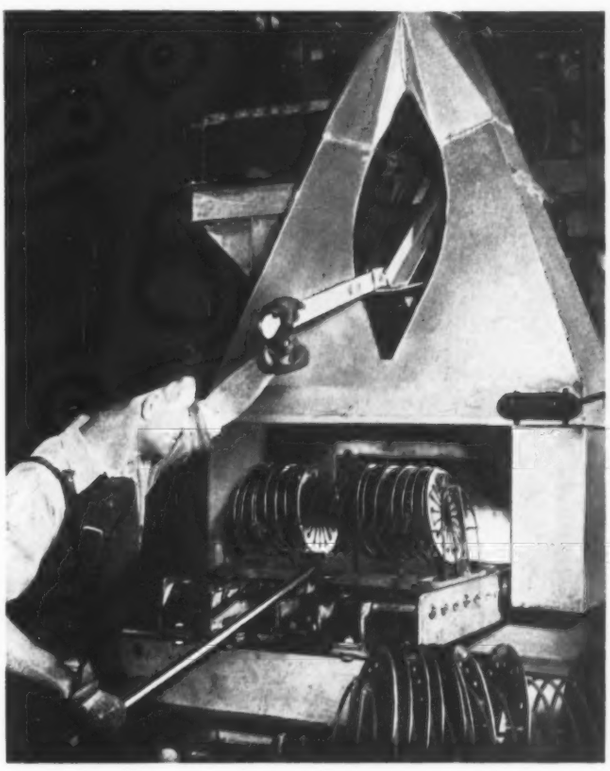


Fig. 2. Racks of Springs are Hardened by Passing Them through an Atmosphere-controlled Furnace and Quenching in Oil without Exposure to the Room Atmosphere

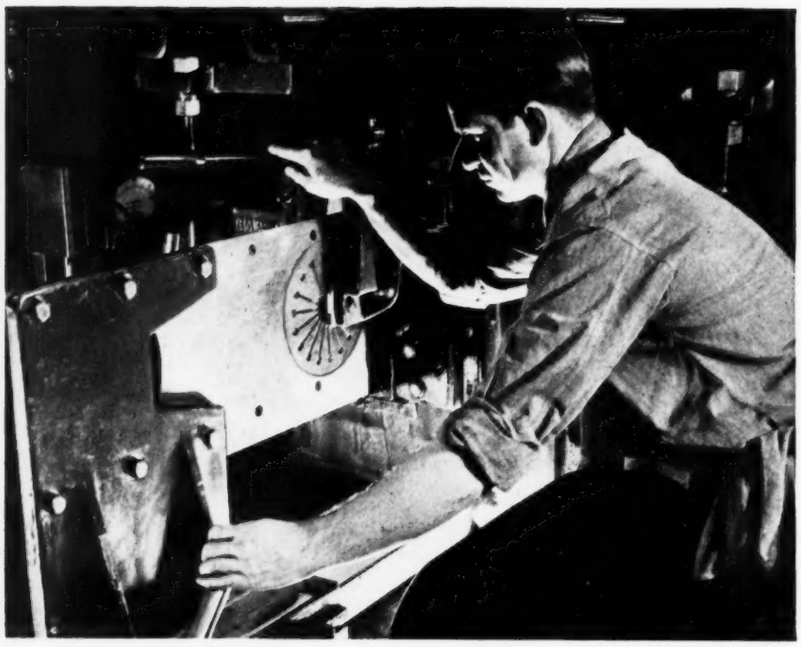
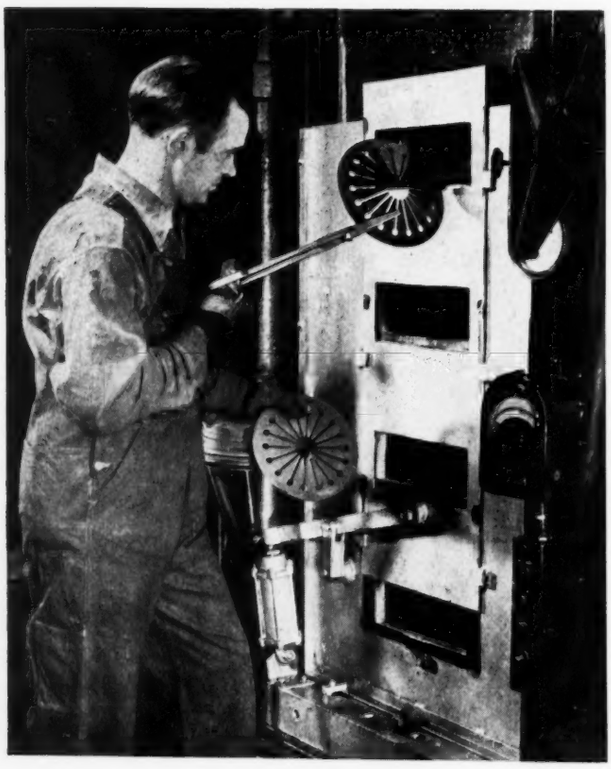


Fig. 3. After Flattening and before Hardening, the Springs are Simultaneously Ground on Both Sides to Obtain the Desired Thickness

Fig. 4. The Conical Shape of the Springs is Produced by Applying a Pressure of 250 Tons while the Springs are Held in Electrically Heated Dies



an atmosphere-controlled gas-fired furnace and quenching in oil. The furnace is operated at a mean temperature of 1475 degrees F. The work passes through a long muffle or tunnel, which is completely sealed from the combustion gases and supplied with a prepared gas that prevents scaling of the springs during the hardening process. The furnace muffle is sealed at the loading end by means of a door, which is raised by the operator with the lever seen in Fig. 2 when a rack of springs is to be placed in the furnace.

A pusher-bar advances the racks intermittently until they reach the far end of the furnace, where automatic equipment lowers them into the quenching tank without exposure to the room atmosphere. The racks are carried through the quenching tank to an elevator that raises them to a roller conveyor on which they are transported to a washing machine. The springs now have a hardness of from 62 to 65 Rockwell C.

From the washing machine the racks of springs are automatically fed into a tempering furnace, also gas-fired, which is operated at a temperature of 750 degrees F. The racks are pushed through this furnace automatically, the operation requiring one hour and forty minutes. When they are discharged, the springs have a hardness of from 50 to 54 Rockwell C.

An overhead conveyor next carries the springs to a battery of 250-ton hydraulic presses of the type

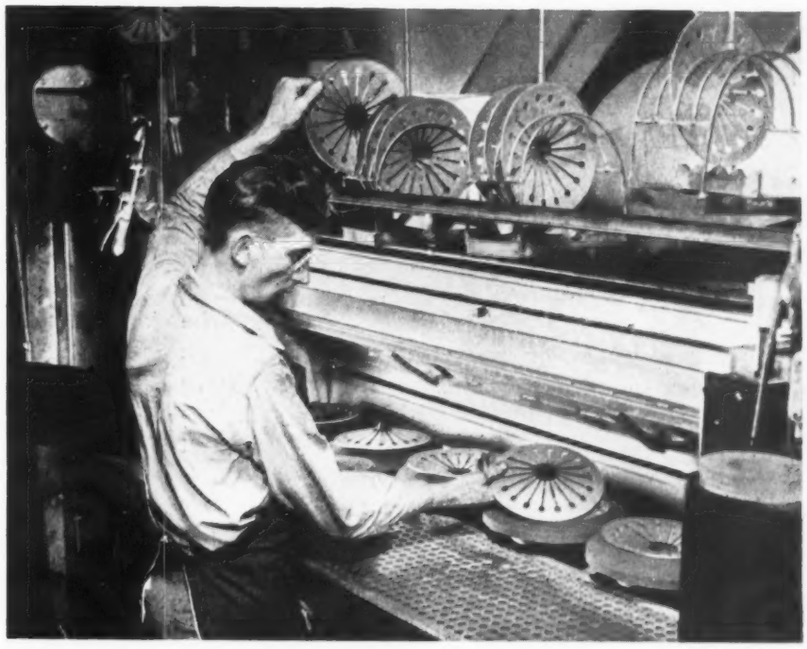


Fig. 5. The Strength of the Diaphragm Clutch Springs is Increased Considerably by Shot-blasting Both Sides in This Machine

illustrated in Fig. 4. Each of these presses is equipped with five dies electrically heated to 900 degrees F. One spring is placed in each of the dies and pressure is exerted simultaneously on all the dies for a period of three minutes. When the springs are taken from these presses, they have been transformed from flat slotted disks into conical parts with sides having a slope of about 14 degrees; upon the completion of all the operations, however, this angle is about 12 degrees. The hydraulic press operation also reduces the hardness to about 42 Rockwell C.

The next operation consists of blasting both sides of the springs with No. 32 steel shot in the machine illustrated in Fig. 5. The springs are brought to the machine from the hydraulic presses by an overhead conveyor. The operator removes the springs from the conveyor and places them on rubber chucks that revolve as they move around a vertical path through the machine. Two styles of chucks are employed, so that the springs can be run through the machine twice, first with one side and then with the other, uppermost.

The steel shot is directed straight downward on the work by an air blast. The shot peens over minute grinding marks on the spring surfaces, and by compressing the surface metal all over, greatly increases the fatigue resistance of the springs.

The springs are now completed as far as physical characteristics are concerned. There are, how-

Fig. 6. After being Magnetized, the Springs are Dipped into a Magnaflux Bath, which Makes the Most Minute Cracks Readily Apparent to the Naked Eye

ever, a number of unusual inspections. First, each spring is placed in a machine which flexes it 7/8 inch past the center, or flat position. The flexing is accomplished by means of two vertical rams, each spring being subjected to three strokes. The purpose of this operation is to develop any potential cracks in the springs.

The cracks are then detected by immersing the springs in a Magnaflux bath, as illustrated in Fig. 6, after they have first been magnetized by placing them in a simple electrical fixture. The springs are placed on racks for immersing in the Magnaflux bath which holds metallic powder in suspension. The magnetism in the springs causes the metal powder to cling to their surfaces, and thus makes even the most minute cracks readily apparent to the eye. An air hoist facilitates handling the spring racks in this operation. After the inspection for visible defects, the metallic powder is completely removed by rolling the springs down the chute of the demagnetizing device shown in Fig. 7.

Each spring is next checked to determine the load required to flex it flat. This inspection is performed with the special weighing scale shown in Fig. 8, which is provided with a hydraulic press at one side, in which the springs are placed one at a time. Then the operator depresses a foot-valve to actuate the press ram. With the clutch spring flat, as indicated by a dial finger on the scale, the operator observes the applied load shown by a second indicator on the scale. Limits of 1070 and 1310 pounds are specified.

To determine whether each spring has a hardness between 40 and 45 Rockwell C, machines of the type shown in Fig. 9 are used. Another fixture is used for inspecting the various holes, to see whether they are of correct size and in their proper

Fig. 7. Rolling the Springs through a Simple Electrical Fixture Demagnetizes Them and Frees Them from the Metallic Powder of the Magnaflux Bath

Fig. 8. Each Spring is Tested in a Hydraulic Press Attached to a Weighing Scale as Shown, in Order to Determine the Load Required to Deflect it Flat

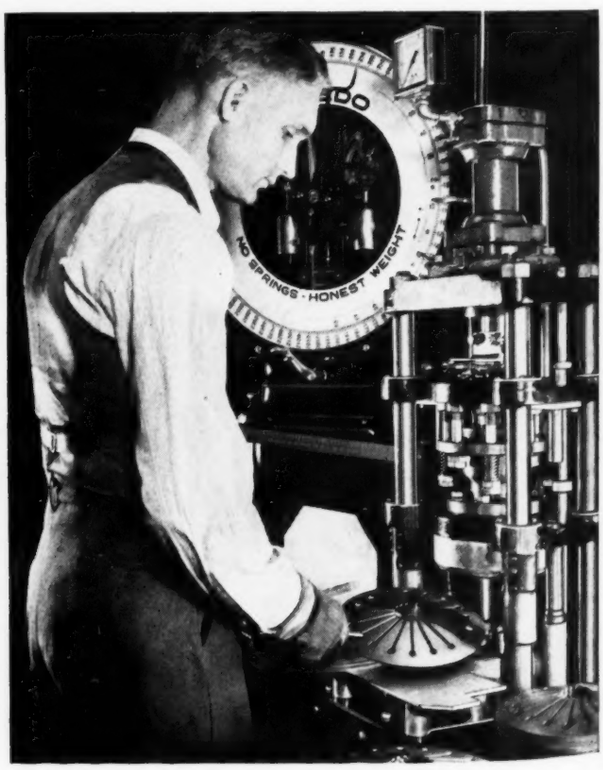


Fig. 9. Battery of Hardness Checking Machines Used in the Series of Inspections that Complete the Manufacturing Operations on the Clutch Springs

locations. The angle of the conical surface is also checked.

Periodic checking for fatigue resistance is performed in a machine that repeatedly flexes the springs 7/16 inch past center, this being the amount that they are flexed in actual service. In this inspection the spring is supported near its periphery on nine pins and flexing is accomplished by means of a ball bearing mounted on an eccentric shaft. The outer ball race rides on a plug attached to a plate that is seated on the clutch spring. This plate can be adjusted to regulate the amount of spring deflection. In one of these fatigue resistance tests, a spring must withstand 750,000 deflections without fracture. Some of the springs have been flexed more than 9,000,000 times before any cracks developed.

All Cams and Bearings of Buick Camshafts are Faced in Seneca Falls Lo-Swing Lathes, and One Bearing is Turned in the Same Operation. The Special Steady-rest at the Back of the Lathe is Fitted with Rollers that Ride on Previously Turned Bearings on the Camshafts

Broaching Cylinder Blocks and

By MILLARD ROMAINE
The Cincinnati Milling Machine Co.
Cincinnati, Ohio

MACHINING operations in the new engine plant of the Chevrolet Motor Co. at Tonawanda, N. Y., are representative of the most advanced practice in the automotive industry. Among the outstanding operations are the surface broaching of the combined cylinder block and crankcase, and of the cylinder head. The cylinder block is broached on the surfaces seen finished in Fig. 3 by the huge horizontal machine illustrated in Fig. 1, which performs all the broaching cuts at a production rate of 60 cylinder blocks an hour, counting on an efficiency of approximately 80 per cent.

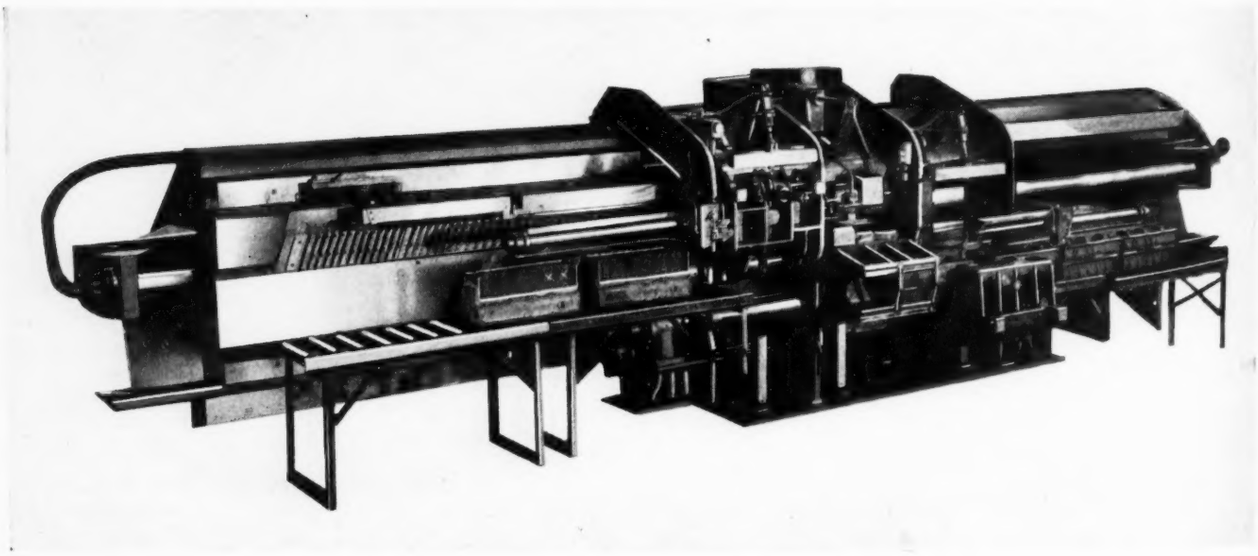
The hydraulically operated broaching ram is equipped with two sets of broaches which operate in opposite directions to broach first the bottom or pan-rail surface of a cylinder block held in the right-hand fixture, and then the top or cylinder-head joint surface, the valve-chamber cover pad (at right angles to the top), and an angular pad on one side of a second casting held in the left-hand fixture. Both the fixtures swing through 180 degrees to carry the work from the loading position to the broaching position and vice versa.

Between the two fixtures is a power-operated mechanism that receives the casting from the first-operation fixture and turns it through 180 degrees to bring the top uppermost, into the proper position to enter the second-operation fixture. Each fixture is alternately swung into and out of the broaching position in synchronism with the ram movements, so that broaching is practically continuous. While the casting in one fixture is being broached, the other fixture is being reloaded. The only time that the broaches are not actually removing metal is during the fraction of a minute required to swing the fixtures into and out of the broaching positions.

For the first operation, the cylinder block is loaded into the right-hand fixture, as shown in Fig. 4, being locked against six cast bosses or spots. Two fixed and two equalizing supports insure proper location in the plane parallel with the cylinder bores, while the remaining two supports under the pan-rail flange locate the casting at right angles to the cylinder bores.

The work is held down against the two bottom supports by finger-clamps applied in the Welch plug

Fig. 1. Huge Cincinnati Horizontal Hydro Broaching Machine which Finishes Chevrolet Cylinder Castings as Shown in Fig. 3



Heads in the Latest Engine Plant

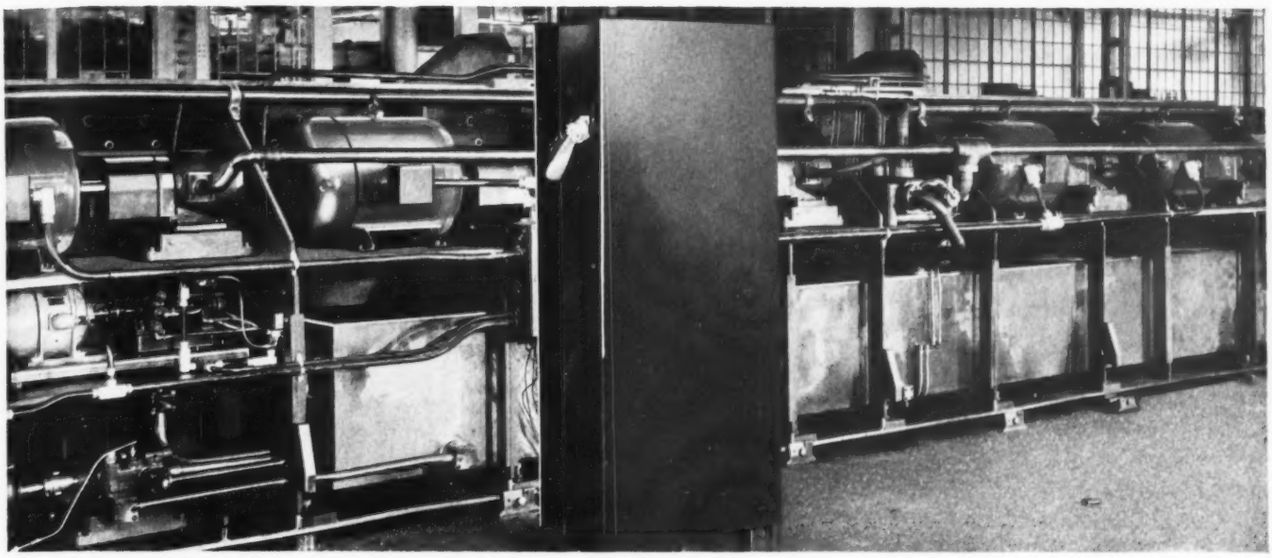


Fig. 2. Five Constant-displacement Pumps, Arranged on the Back of the Machine as Shown, Provide the Pressure for the Hydraulic Operation of the Broaching Ram, Work Fixtures, and Work Transfer Mechanism

holes, and is pushed against the side locating points by a rail that also acts as a guide bar. The two adjustable supports are tightened against the two ends of the top surface on the side away from the vertical fixed locating path. Care was taken in designing the fixture to prevent any preloading or distortion of the castings. End pressure is taken by a fixed equalizing stop on the main fixture frame, against which the work and the fixture are pushed by the action of the broaching tools. The first-operation cuts are taken as the broaches move from right to left.

In the second-operation fixture, the work rests on the finished bottom or pan rail, and is lined up from two of the foundry spots used in the first operation. It is clamped on the flange by spring-operated clamps which are released by the movement of one lever. The broaches for the second operation cut from left to right.

The transferring of the cylinder castings from the conveyor that brings them to the machine, into and out of the fixtures and the transfer device, and to the exit conveyor, is all accomplished by hand-controlled hydraulic pressure. The operator's duty is limited to manipulating levers in the proper sequence, plus the exertion of a slight effort to push the castings 1/4 inch or so in the fixtures against the locating side and end stops.

Cylinder heads are broached by the same general procedure, except that power transfer equipment is not required, since the castings are light enough for the operator to push into and out of the fixtures and the turn-over device without much effort. The first operation on the cylinder head consists of broaching the top and the valve-chamber cover face. The second operation consists of finishing the joint and manifold faces. The hourly production is the same as with the cylinder castings.

Production figures are based on a stock removal of approximately 5/32 inch from the solid, or a maximum of 3/16 inch, including fins, etc. As tested on a surface plate with a dial indicator, the maximum variation of any surface from a true plane is less than 0.003 inch, and the parallelism and squareness are also within 0.003 inch.

The broaches for the major surfaces are made with individual cutting blades clamped in a holder, as shown in Fig. 5. With the exception of a final tungsten-carbide blade, the blades are all of case-hardened high-speed steel. The method of holding

Fig. 3. Chevrolet Cylinder Castings are Broached on the Bottom or Pan Rail in the First Operation, and on the Top, Valve-chamber Cover Pad, and Angular Pad in the Second Operation

each blade in its slot insures maintenance of the initial accuracy of the broach-holder; whatever wear takes place through repeated tool changes occurs in the replaceable screws and nuts.

The thickness of the chip made by each blade is determined by the depth of its slot in the broach-holder. The blades are not all of the same design, but are of the same cross-section. For sharpening, therefore, the blades are all removed from the broach-holder, set up on an ordinary surface grinder, and ground on one surface only—all to exactly the same dimension. Each blade has two cutting edges, so that the first time the tools become dull, it is only necessary to reverse them in the holder. Each blade is stamped with a letter, and the corresponding slot in the holder is similarly stamped. Since there are a number of duplicate blades in a set, any blade stamped with a certain letter can go into any slot having the same letter.

The work-holding fixtures are provided with an adjustment of approximately 1/8 inch, and the broaches project beyond the holder somewhat more than that amount. This means that until the tools have been worn down as much as 1/8 inch, adjustments for size are made on the fixture. When the tools have been worn down more than that, each blade is backed up by a shim 1/8 inch thick and the fixture is then set back to the starting position. When a second 1/8 inch has been ground off the blades, a 1/4-inch shim is substituted, and so on. With three sets of shims 1/8, 1/4, and 1/2 inch thick, it is possible to secure a total of 1 inch of broach life. Assuming an average reduction in blade size of 0.010 inch per grind and an average life of 2500 castings per sharpening of a blade, 250,000 cylinder blocks can be broached with one set of inserts.

The broaches that are employed for the valve-chamber cover face and the angular pad on the cylinder block, as well as for the valve-chamber cover face and the manifold pad on the cylinder head, are of the conventional integral-tooth type. It will be obvious that the tool cost per piece of work may be extremely small. Including time for sharpening, replacing blades, etc., the total cost should not exceed 3 3/4 cents per cylinder block and 3 1/4 cents per cylinder head.

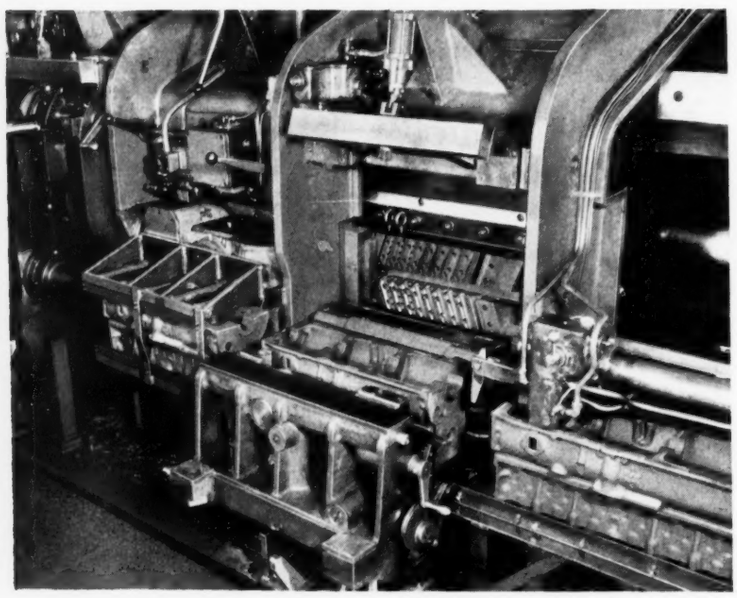


Fig. 4. The First-operation Fixture in the Loading Position, the Work Transfer Device being Seen at the Left with a Casting about to be Indexed into Position for the Second-operation Fixture

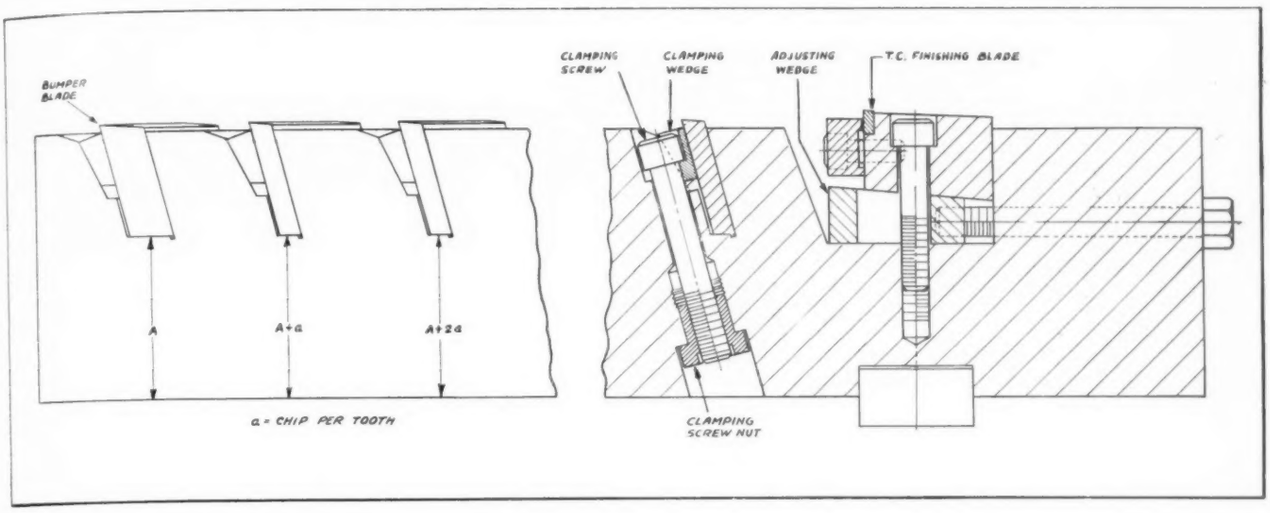


Fig. 5. Construction of the Broach-holder, Broaching Blades, and Blade Clamping Devices Provided for Broaching the Major Surfaces of the Cylinder Blocks and Heads

The structure of both machines has been built up entirely by welding. The moving ram, which contains the operating cylinder and carries the broaches, rides upon replaceable hardened wear strips which are generously supplied with lubricant under pressure. The double-end piston-rod is fastened to both ends of the machine frame, and thus provides a uniform ram speed in both directions. The hydraulic equipment includes five Vickers constant-displacement pumps with individual motor drive, arranged on the back of the machine as illustrated in Fig. 2. The Cincinnati patented load-and-fire relief valve is used in the hydraulic system.

In designing these machines, special care was taken to minimize the "down" time occasioned by the necessity of cleaning chips out of the fixtures and the machines. The fixtures were therefore made self-cleaning, there being no places for chips to collect. The chips fall vertically into a trough located between the fixture frame and the face of the broach ram. The ram itself carries a wiper which cleans this trough at every stroke, pushing the chips into a conveyor.

The time required for changing tools when they become dull has also been reduced to a minimum by providing sets of tool-holders with inserts mounted in them, so that a complete tool change can be made in less than an hour.

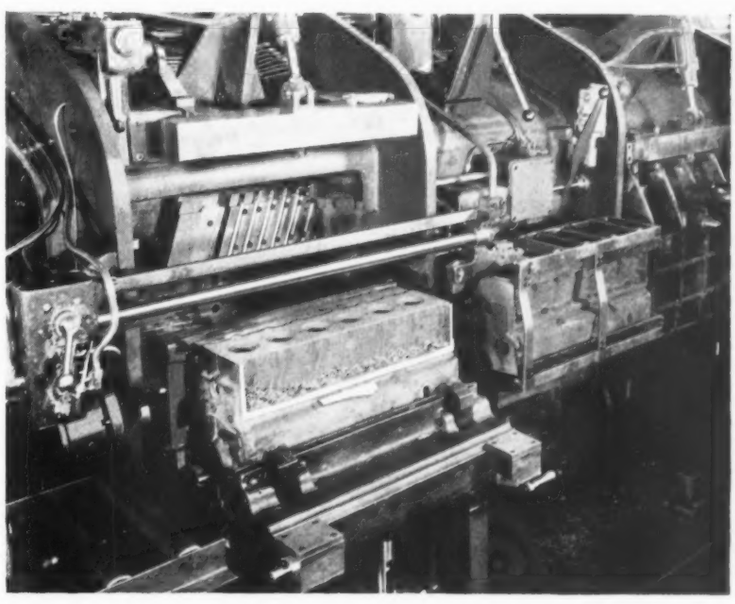
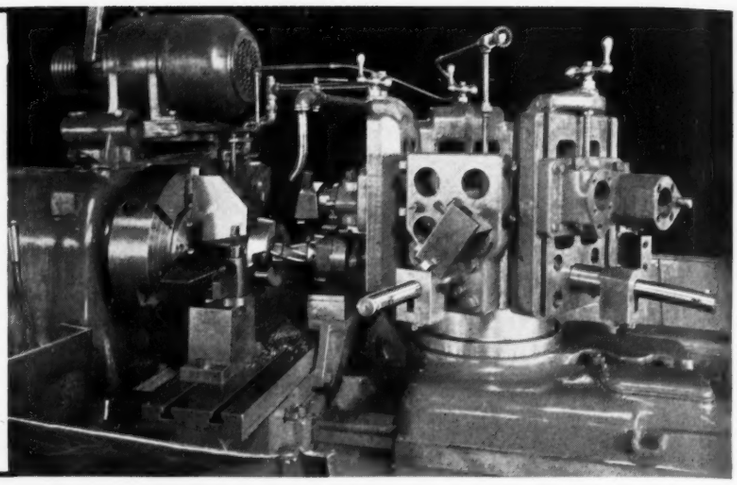


Fig. 6. View of the Second-operation Fixture with a Cylinder Casting about to be Unloaded; at the Extreme Right, the First-operation Fixture may be Seen in the Broaching Position

Machining Differential Cases



AN automatic chucking machine and complete special tooling for the roughing and finishing of drop-forged differential cases of the type shown in Fig. 3 were recently supplied by the Potter & Johnston Machine Co., Pawtucket, R. I., to an important manufacturer of automotive products. These differential cases are machined in two chuckings. The surfaces finished in the first chucking are indicated by heavy lines in the illustration, while those machined in the second chucking are indicated by short cross-hatch lines. The floor-to-floor time in the first chucking is 17 minutes, and in the second chucking 18 minutes. The total depth of stock removed ranges from 1/8 to nearly 1/2 inch, the rough forging being indicated by dot-and-dash lines.

Before the differential case comes to the automatic chucking machine, the hole is rough-bored the entire length of the forging to a diameter of 1 5/8 inches. For the first chucking, which is illustrated in Figs. 1 and 2, the part is gripped by the hub end in a three-jaw chuck. It is located and backed up in the chuck by means of the three jaws, each of which is fitted with a stop-pin.

In the first step of this chucking, which is seen in progress in Fig. 1, the main bore is machined to a depth of about 3 3/4 inches by a shell drill. The large end is also rough-turned and counterbored to a diameter of 6.875 inches, all of these cuts being taken by tools mounted on the turret. At the same time, the large end is faced to the 6.875-inch counterbore by a tool mounted on the front cross-slide. Then the turret is indexed to bring the second face in line with the work for boring the hole and rough-machining the 2 3/4-inch counterbore.

A single-point cutter mounted on a slide on the third face of the turret, which is shown in the working position in Fig. 2, finish-faces both counterbores. This tool is fed by the rear cross-slide while the turret dwells at the forward end of its stroke. The 2-inch hole is next finish-bored by a tool mounted on a bar extending from the fourth

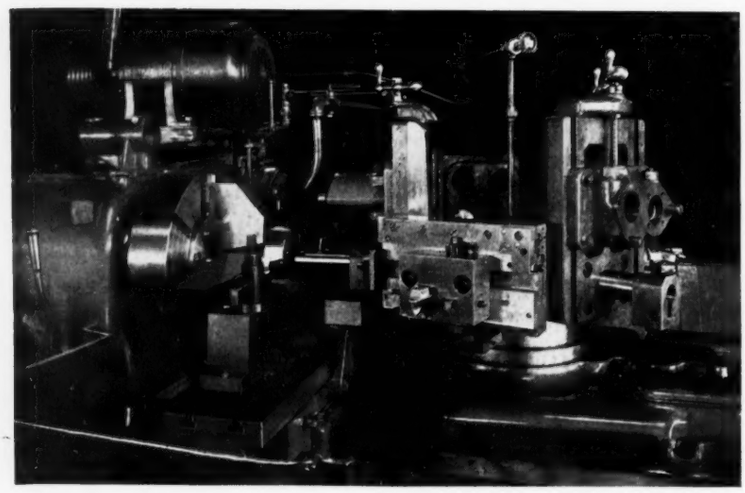


Fig. 1. (Above) Tooling Provided on a Potter & Johnston Automatic Chucking Machine for the First Operation on a Drop-forged Differential Case of the Design Shown in Fig. 3

Fig. 2. (Left) Another View of the Operation Illustrated in Fig. 1, Showing the Remainder of the Turret Tooling. The Third Step of the Operation is in Progress

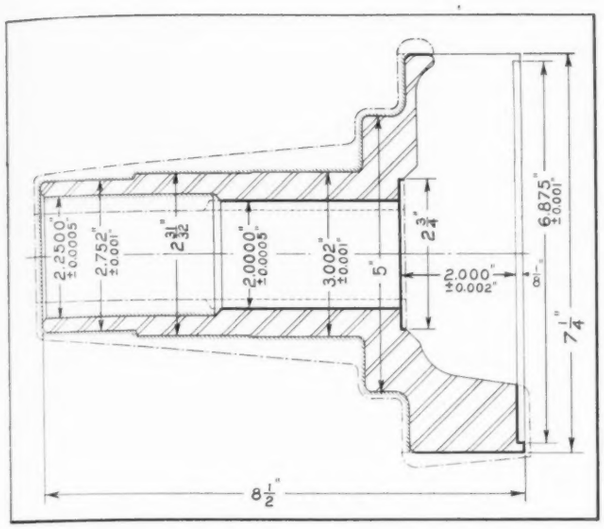


Fig. 3. Cross-sectional View of the Forged Differential Case of SAE X1340 Steel, which is Roughed and Finished in Two Operations Performed in an Automatic Chucking Machine

turret face, the large end of the forging being finish-faced at the same time to the 6.875-inch counterbore by a tool on the rear cross-slide.

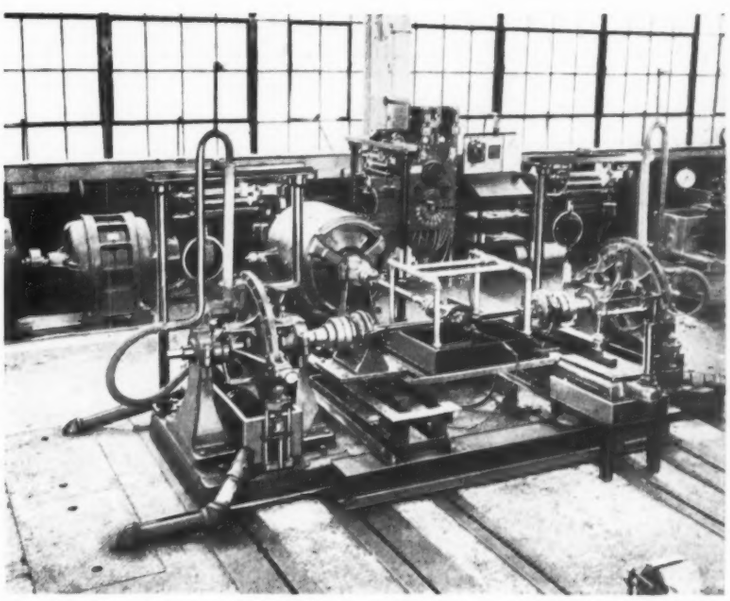
The final step of this chucking, performed by tools on the fifth face of the turret, consists of reaming the hole to 2.000 inches, and size-boring the 6.875-inch counterbore and chamfering the edge of this counterbore with a small cutter.

For the second chucking, which is performed on the same machine equipped with a different set of special tools, the finished 6.875-inch counterbore of the differential case is located on a hardened and ground ring attached to the face of the chuck, and the part is held in position by three clamps. The first step of the second chucking consists of rough-boring the hole in the hub end to a depth of 3 1/8 inches, rough-turning and facing the 5-inch diameter shoulder on the back of the large end, rough-facing from this shoulder to the large diameter, and rough-turning the hub for its entire length. All the turning cuts are taken by tools on the turret, while the facing cuts are performed simultaneously by tools on the front cross-slide.

The second step of this chucking consists of finish-turning the hub to the two smaller diameters and rounding the corners of the head and the shoulder, all of these cuts being taken by tools on the turret. The left end of the hole, as seen in Fig. 3, is next finish-bored by a tool mounted on a bar extending from the third turret face, and at the same time, tools on this turret face finish-turn the surfaces that were just rough-turned. The hole and the end of the hub are also chamfered.

The back of the forging head, the shoulder, and the hub are next finish-faced by tools mounted on the fourth face of the turret, which are actuated by the rear cross-slide.

The final step consists of reaming the hole in the end of the hub to 2.250 inches and reaming a bushing that was assembled in the 2-inch hole between the first and second chuckings. The cutters are mounted on a bar on the fifth face of the turret.



Automobile Rear Axles and Transmissions, together with Bearings Used in Them, Tested in a 75-100-horsepower General Electric Dynamometer in the Laboratory of the Timken Roller Bearing Co. A Speed Range of from 200 to 4000 Revolutions per Minute is Available on the Propeller Shafts. The Axles are Loaded at the Spring Pads, which Assures that the Housing will Deflect in the Same Way as under Service Conditions

Precision Boring Applied

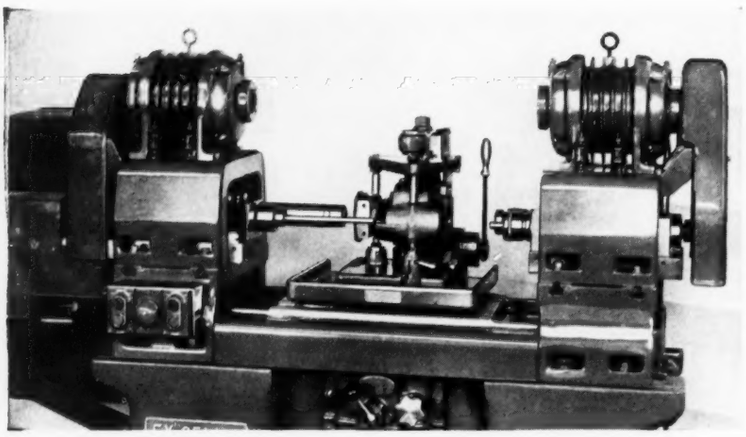


Fig. 1. Precision Boring Machine Equipped for the Finish-boring of Two Holes in Each End of an Automobile Transmission Case at One Setting of the Work

THE variety of automotive parts having holes that are finished to a high degree of accuracy in machines of the precision boring type has recently been augmented by the application of this finishing method to transmission cases. The accompanying illustrations show equipment supplied by the Ex-Cell-O Corporation, Detroit, Mich., for the precision boring of two different transmission cases.

An operation that consists of finish-boring two holes at each end of a cast-iron transmission case with one setting of the work at a production rate of 80 cases an hour, based on an efficiency of 80 per cent, is illustrated in Figs. 1 and 2. This transmission case is located on three centers which are adjustable for height, and rests on a bracket that contains a live bearing for piloting the long slender boring-bar of the left-hand head. A handle on the right-hand side of the fixture operates an overhead spider clamp that is swung into place by swiveling a vertical post. This clamp holds the part down under a heavy spring pressure.

Two holes are bored in the left-hand end of the transmission case in the first step of the operation by rapidly traversing the fixture toward the left-hand head and then feeding at a slow rate for the actual cutting. These holes are of 0.870 inch and 2.834 inches diameter, respectively. The long piloted boring-bar for the small hole is positioned radially before the movement of the fixture starts, by means of an electrically operated mechanism, in order to allow the boring cutter to clear a pad on the work. The large hole in the same end of the part is bored simultaneously by a tool in the extended type of spindle at the rear of the head.

After the boring of the two holes, the boring-bar for the small hole is again automatically positioned to clear the pad on the transmission case when the fixture travels toward the right-hand head.

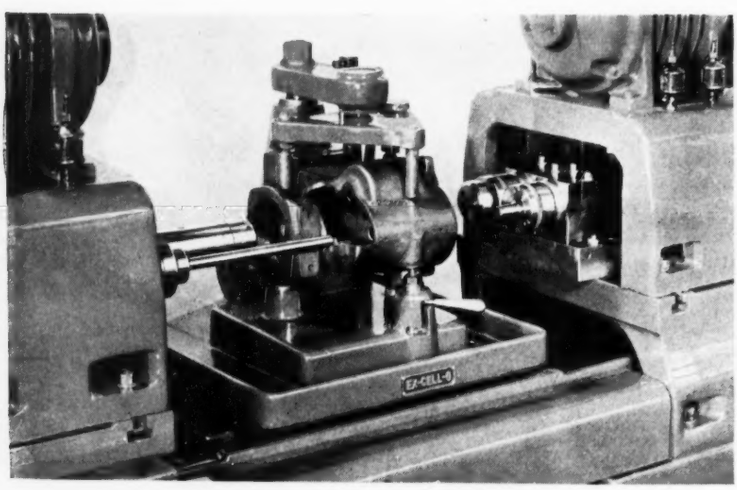


Fig. 2. Close-up View of the Special Work Fixture and Tooling Provided on the Machine Illustrated in Fig. 1 for the Precision Boring of a Transmission Case

to Transmission Cases

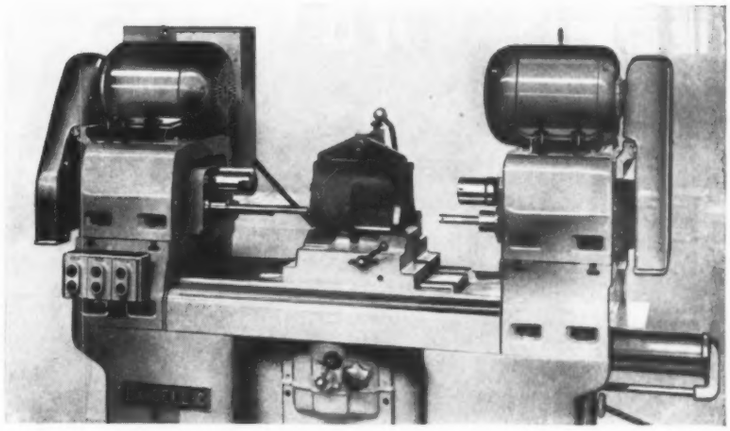


Fig. 3. Another Precision Boring Machine Equipped for Finish-boring Three Holes in One End of a Transmission Case and Two in the Opposite End

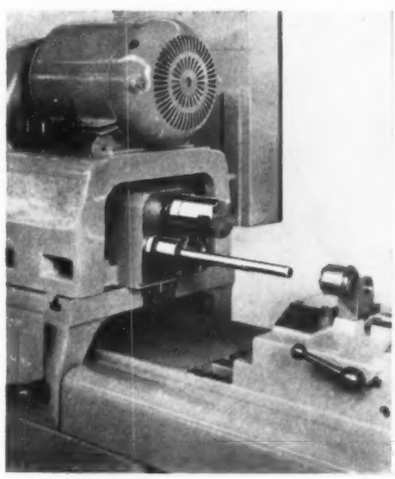
The holes in the right-hand end of the part are bored by tools mounted on the ends of short spindles, these holes being 0.870 inch and 2.440 inches in diameter, respectively.

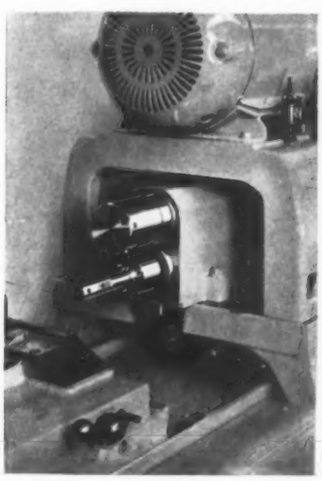
The small boring-bars of both heads run at speeds of 1750 revolutions per minute, while the extended type spindles run at 530 and 625 revolutions per minute. The feed of the large-diameter cutters, is 0.010 inch per revolution, and the amount of stock removed from the various bores ranges from 0.008 to 0.010 inch on the diameter. The length of the longest cut taken by the left-hand head is 1 1/2 inches, and by the right-hand head, 25/32 inch.

The operation illustrated in Fig. 3 consists of finish-boring three holes in one end of another type of transmission case, and two holes in the opposite end. This transmission case is located from the clutch housing face and from one bolt-hole in the flange. The part is clamped by operating a handle that lowers an equalizing bar.

The long bar on the left-hand head of the machine, which bores two holes to 0.875 inch diameter, in line, is guided in a special pilot bearing in the center of the work fixture. This bearing, as seen in Fig. 4, has six splines which engage keys on the long boring-bar.

The holes bored by the large-diameter spindles are each 3.1497 inches in diameter, while the small holes are 0.875 and 1.000 inch diameter. The large spindles revolve at 500 revolutions per minute and the small boring-bars at 1500 revolutions per minute. The feed per revolution of the large spindles is 0.006 inch, and of the small boring-bars, 0.002 inch. The amount of stock removed by each tool is 0.030 inch on the diameter. The total length of the feed movements, not including the rapid traverse, is 3 9/16 inches. The production, based on an efficiency of 80 per cent, is 30 an hour.





Figs. 4 and 5. Close-up Views of the Left- and Right-hand Ends of the Precision Boring Machine Illustrated in Fig. 3, Showing the Special Tools and Work Fixture

Packard Adopts Process for

CRANKSHAFTS hardened by the Tocco process have been used in Packard automobiles for the last four or five years with such satisfactory results that the concern has now adopted the same method for hardening camshafts. It is the first application of the Tocco process by any concern to this kind of part. The hardening equipment has been installed in the camshaft machining lines at the Packard plant in Detroit. It was supplied by the Ohio Crankshaft Co., Cleveland, Ohio, owners of the patents which cover this method of heat-treating.

There are two groups of four hardening machines each, one group being used for six-cylinder camshafts and the other for eight-cylinder camshafts. While the machines of one group are in operation, those of the other group are reloaded.

With this method of hardening camshafts, all the cam lobes, the integral helical gear, and the eccentric for driving the fuel pump are hardened to from 58 to 60 Rockwell C to a depth of about 1/8 inch. This gives a hard outer case with a tough core. Only the surfaces on which hardness is essential are heat-treated, the original toughness of the material being retained at all other points.

These camshafts are forged from S A E 1045 steel, which contains somewhat more carbon than the steel generally used for camshafts that are carburized and casehardened by conventional methods. This makes the camshafts slightly more difficult to machine, but the advantages of the Tocco heat-treating process are said to more than compensate for the increased machining difficulties. Hardening is performed after all other operations, with the exception of finish-grinding. Stock to a depth of 0.005 to 0.006 inch is removed from the hard surfaces in the finish-grinding operations.

Briefly, the Tocco process consists of electrically heating and then quenching with water, individually, each of the surfaces to be hardened. This is accomplished by placing the camshafts, as shown in Fig. 1, between centers mounted on vertical slides, the bottom center in each case being spring-backed to facilitate loading. Each machine is made with one slide for hardening two camshafts simultaneously. After the four machines of a group have been loaded with the work-slides in the raised position, as shown in Fig. 1, the windows at the front are closed and the operator pushes an electric switch button to start the machines.

With the camshafts rotating at about 60 revolutions per minute to insure uniform heating, they are lowered in successive steps to bring each cam

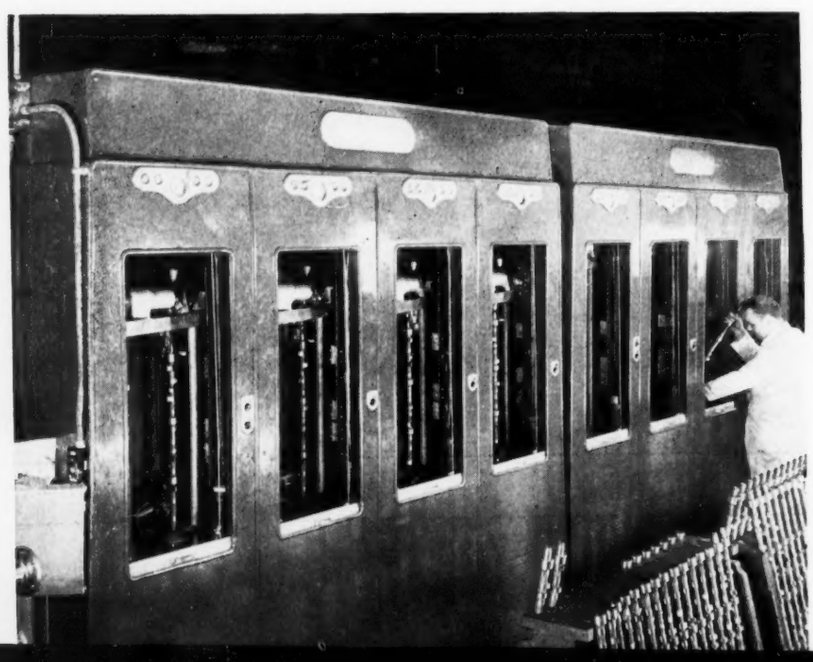
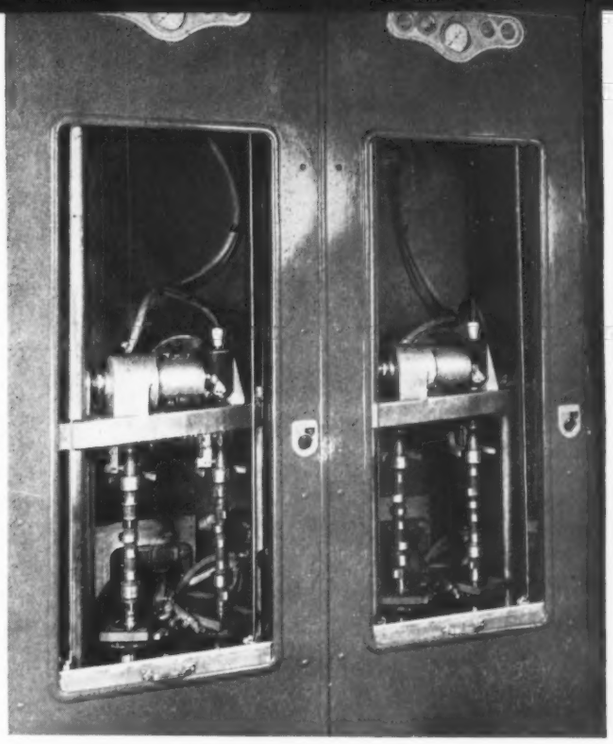


Fig. 1. (Above) Camshafts for Packard Automobiles are Hardened on the Cam Lobes, Helical Gear, and Eccentric in Tocco Hardening Machines which Heat Electrically and Quench

Fig. 2. (Left) General View of the Two Groups of Tocco Hardening Machines in the Packard Plant, One being Used for Six-cylinder Camshafts, and the Other for Camshafts of Eight-cylinder Engines

Tocco Hardening Camshafts



lobe, the helical gear, and the eccentric within the inductor blocks seen in Fig. 4. These downward or indexing movements of each work-slide are effected automatically by means of a hydraulic piston and cylinder, and the indexing is controlled by an air-operated plunger at the top of the slide which engages notches on a fixed vertical bar.

As each cam lobe or other surface of the camshafts is brought into the openings in the inductor blocks, 100 kilowatts of electric current at high frequency passes around the surfaces to be hardened and heats them to a temperature of approximately 1500 degrees F. within 4 1/2 seconds. Then cold water is sprayed on the heated surfaces for a period of 7 1/2 seconds through a series of holes in the inductor blocks.

The vertical slide then indexes downward to bring the next cam lobe or other surface of the camshafts into the inductor blocks. The operation of the indexing plunger, the duration of the electric heating, and the period of quenching are all controlled by an automatic timing device. At the end of the operation the work-slide is automatically returned to its loading position by the hydraulic mechanism. Water at about 75 pounds per square inch pressure is used in the hydraulic system.

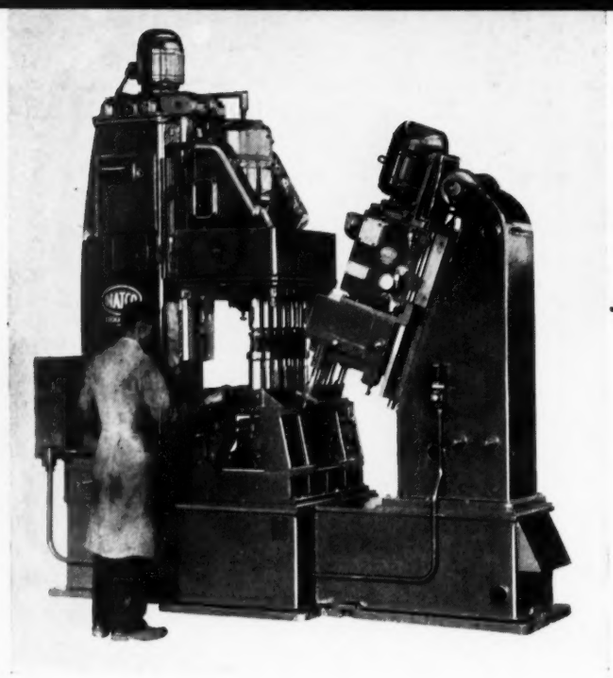
To reduce the electrical requirements of this equipment, the machines of each group are so timed that no two machines are heating work at the same time, with the result that a generator set of 200 kilowatts capacity is sufficient for the installation. Alternating current of 2000 cycles, 800 volts and low amperage, is produced by the generator set and transformed to 25 volts and high amperage for delivery to the inductor blocks. As this heavy current passes through the inductor blocks, it sets up a magnetic field which heats the work surfaces to the required temperature. A current of high frequency is used, because the higher the frequency, the greater the tendency of the electricity to cling to the surfaces of the work instead of penetrating to its center.

High speed is a feature of this process, the camshafts for eight-cylinder engines, which have eighteen surfaces to be hardened, being hardened by one man at the rate of one camshaft every 1 1/2 minutes. The camshafts for six-cylinder engines have fourteen surfaces to be hardened, and are handled at the rate of one camshaft every minute.

Uniformity of hardening is assured by this process, because once the operating cycle has been established and the power supply adjusted, the human element is eliminated.

Fig. 3. (Above) The Camshafts are Mounted Vertically for the Hardening Operation and Indexed Downward to Bring the Surfaces to be Hardened within Electrical Inductor Blocks

Fig. 4. (Right) The Two Inductor Blocks of a Tocco Hardening Machine which Heat Various Camshaft Surfaces to 1500 Degrees F. and then Quench Them with a Water Spray Delivered through Holes in the Blocks



Multiple-Head

Fig. 1. Machine for Simultaneously Chamfering the Top and Bottom Ends of the Cylinder Bores in Engine Blocks, and Drilling Four Holes in the Distributor Pad and Boss. The Production is Eighty-five Cylinder Blocks per Hour

THE machines here shown have recently been built by the National Automatic Tool Co., Richmond, Ind., for the performance of drilling, tapping, reaming, counterboring, and chamfering operations in automobile plants. These machines are based on the principle of using the self-contained sliding-head spindle units known as "Natco Holeunits" in combination with "Holesteel" vertical machines and columns, bases, work fixtures, etc., built up to meet specific requirements.

The machine shown in Fig. 1 is equipped for chamfering the top and bottom ends of the bores in six-cylinder engine blocks, and for drilling four holes in the distributor pad and boss. The chamfering cutters are carried by the spindles of the Holesteel machine unit at the left, and the drills by the angularly mounted sliding head at the right.

One man loads and unloads the roller conveyor type of fixture and operates the machine through a single push-button station. The chamfering operation at the top of each cylinder bore is performed by a revolving tool that is fed vertically, while the chamfering operation at the bottom of each bore is performed by a revolving tool that is fed both vertically and horizontally. The tools are piloted in the cylinder bores. One operator maintains a production of 85 cylinder blocks an hour under normal conditions.

Forty cuts are taken on cylinder heads by the equipment illustrated in Fig. 2, which is built up of three Holeunits, a tapping unit with a reversing motor drive, a vertical Holesteel machine, and a four-position hydraulically operated indexing table. The first position of the table is used for loading purposes. In the second position, the six spark-plug holes in the cylinder head are drilled by the corresponding vertical head, the six intake holes are spot-faced by the left-hand angularly mounted head, and two holes are drilled in the end of the cylinder head by a horizontally mounted head at the rear.

In the third position of the work fixture, combination tools on the vertical head counterbore and chamfer the six spark-plug holes, while the two holes previously drilled in the end of the cylinder head are tapped by a horizontally mounted head at the right-hand end of the machine, in back of the angularly mounted head. The six spark-plug holes are tapped in the fourth position of the work fixture by the third group of spindles on the vertical head, and at the same time, the six exhaust holes are spot-faced by the angular head on the

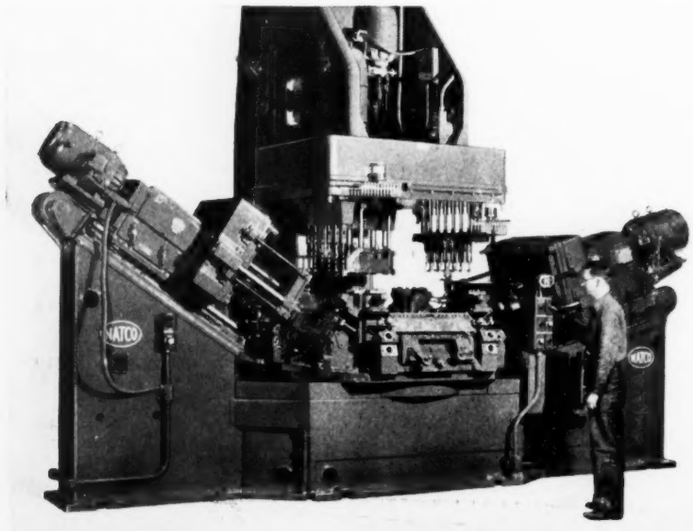


Fig. 2. Indexing Type of Machine which Performs Forty Drilling, Counterboring, Chamfering, and Tapping Cuts on Cylinder Heads. The Machine Has One Vertical Sliding Head with Three Groups of Spindles, Two Angular Heads and Two Horizontal Heads

Machines for Cylinder Work

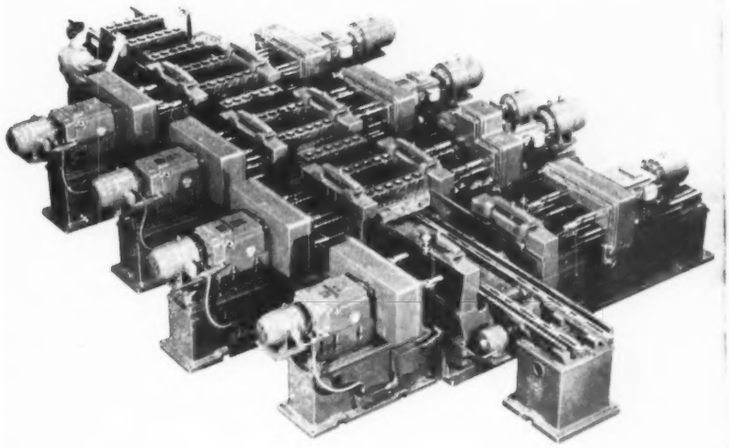


Fig. 3. Battery of Machines Operated as One Unit by a Single Push-button Station for Performing a Total of Forty-seven Cuts on Cylinder Blocks. The Cylinder Blocks are Indexed Automatically, Two at a Time, from Station to Station and Out of the Machine

right-hand side of the base. This machine, with one operator, gives a production of 90 cylinder heads an hour.

Forty-seven drilling, chamfering, counterboring, reaming and tapping cuts are taken on the two ends of a cylinder block by the unusual equipment illustrated in Fig. 3, which consists of eight Hole-units, one auxiliary tapping unit with a reversing motor drive, and a straight-line mechanically indexed type of fixture, together with suitable bases, etc. Two cylinder blocks are held in each indexed position of the fixture for simultaneous machining by the sliding heads of that station. One operator controls the entire machine through a single push-button station.

The cylinder blocks come to the machine on a roller conveyor, and are positioned by the operator in the loading station. They are then automatically indexed in pairs from one station to the next, and are finally unloaded automatically from the machine. The entire equipment is electrically interlocked.

In the first working station of the machine, the left-hand head drills the oil gallery hole to a predetermined depth and drills eight additional holes. At the same time, the right-hand head also drills the oil gallery hole to a predetermined depth. In the second working station, the left-hand head drills the oil gallery hole an additional amount, drills four more holes, and chamfers three holes, while the right-hand head drills six holes.

In the third working station, the left-hand head continues the drilling of the oil gallery hole, rough core-drills one Welch plug hole, spot-drills one hole, drills another hole, and taps two holes. The right-hand head also drills the oil gallery hole and drills three other holes. The left-hand head in the fourth working station completes the drilling of the oil

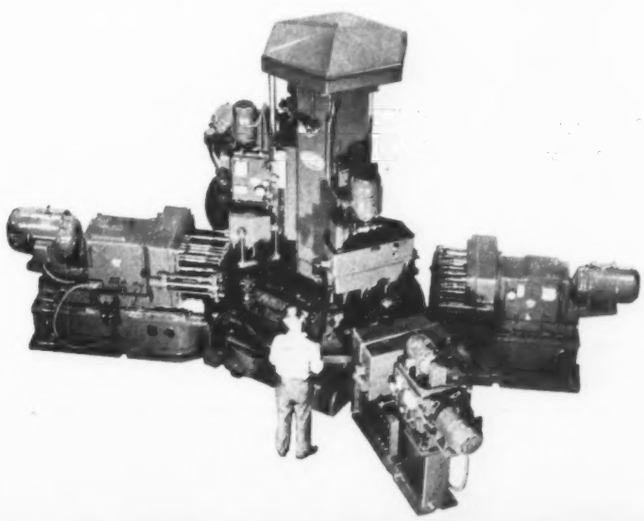


Fig. 4. Rotary Type of Machine with Table that Indexes the Work to a Number of Stations in which Both Horizontal and Vertical Sliding Heads are Provided for Performing Seventy-five Drilling, Countersinking, Spot-facing, and Tapping Operations

gallery hole, finish core-drills and counterbores a hole, and drills five additional holes, while the right-hand head reams and counterbores one end of the oil gallery hole with a combination tool, and finish core-drills and counterbores another hole. This machine handles 90 cylinder blocks an hour.

Seventy-five drilling, countersinking, spot-facing, and tapping operations are performed on cylinder heads by the machine shown in Fig. 4, at a production rate of 90 cylinder heads an hour. One man tends the machine. It consists of six Hole-units, four of them mounted horizontally and two vertically, and two tapping units, one horizontal and one vertical. Each of the tapping units has a reversing motor drive and an individual lead-screw. This machine is used in combination with another machine of the same general type that performs seventy-nine operations on cylinder heads at the same production rate.

Both machines are equipped with six work fixtures mounted on a table that is automatically indexed around a central column. On the machine illustrated, six holes are drilled by the vertical head in the first working station, and twelve holes by the horizontal head in that station. Six holes are countersunk by the vertical head of the second working station, and nineteen holes are drilled by the horizontal head. The next station of the machine is idle and the vertical head of the fourth working station is also idle, but the horizontal head of that station countersinks six holes, spot-faces eight holes, and drills five holes. The vertical head in the final working station taps six holes while the horizontal head taps seven holes.

Hydraulic Automatic Lathe Operations in Automobile Plants

FINISHING operations are being performed to a high degree of accuracy and with high quality on differential gear-cases and flywheels in two automobile shops by means of the Gisholt hydraulic automatic production lathes here illustrated. The machine shown in Fig. 1 finish-machines malleable-iron differential gear-cases of the design shown in Fig. 2, after the cases have been rough-machined in a Fay automatic and recentered by a drilling machine.

In the finishing operation performed in the hydraulic automatic production lathe, the cases are held between centers, as shown in Fig. 3, and driven by an air-operated draw-rod, a C-washer being used to hold the case rigidly to the headstock center. The outer end is held by an air-operated tailstock center.

The front slide is equipped with three tool-blocks for finish-turning both hubs within a tolerance of 0.001 inch and also the ring diameter within a tolerance of 0.003 inch. Simultaneously, three tools on the rear slide finish face and chamfer the ring-gear seats and finish form and face both hubs to length. All tools are Carboloy-tipped.

The feed of the front tools is approximately 0.004 inch per revolution, and of

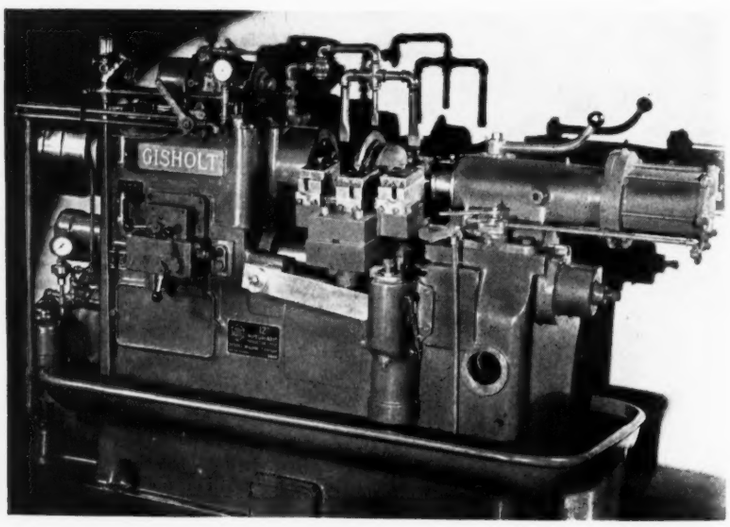


Fig. 1. Hydraulic Automatic Production Lathe which Finishes Differential Gear-cases to Close Tolerances, with a High Quality of Finish

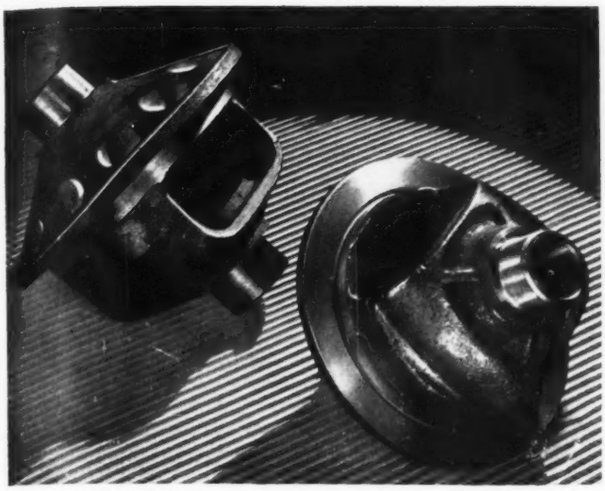


Fig. 2. Differential Gear-cases on which Finish Turning, Facing, Chamfering, and Forming Cuts are Taken by Machine Shown in Fig. 1

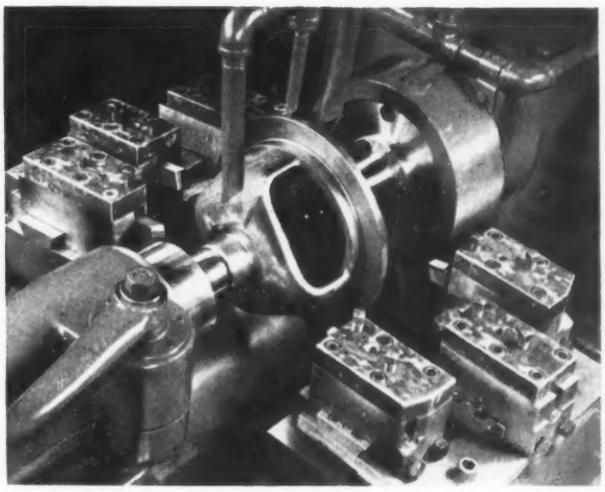


Fig. 3. Carboloy-tipped Tools at Front and Back of Machine Take Cuts Simultaneously on Various Surfaces of Differential Gear-case

the rear tools, 0.003 inch. The maximum surface speed is 500 feet per minute. The floor-to-floor time for a case 9 5/16 inches outside diameter is 1.25 minutes, and for a case 10 1/4 inches outside diameter, 1.14 minutes.

The lateral run-out and eccentricity on the drive-gear seat must not exceed 0.002 inch with an indicator reading, when the case is supported on the hubs. Actually, however, the lateral run-out and eccentricity do not exceed 0.0004 inch. The high quality of finish has eliminated the necessity of grinding operations on these differential cases.

The hydraulic automatic production lathe illustrated in Fig. 4 is used for machining the clutch surface on cast-iron flywheels, four machines of this type having been furnished to one concern for this operation. The operation is performed after the starting gear has been shrunk in place. The flywheel is located in the machine from the crankshaft counterbore and is chucked by means of an air-operated draw-bar and U-washer. Again, Carboloy tools are used.

The cutting speed is held constant at 415 revolutions per minute by employing a variable-pitch, multiple V-belt drive, the adjustment of which is controlled by the movement of the tool-slide. The feed is 0.0165 inch per revolution, and approximately 160 flywheels can be finished per grind of the tools.

In running this machine, the operator only has to move one lever after loading the chuck to start the machine through its cycle. A cycle takes 1.14 minutes. Allowing time for the changing of tools, setting up, etc., the net production is approximately forty wheels an hour per machine.

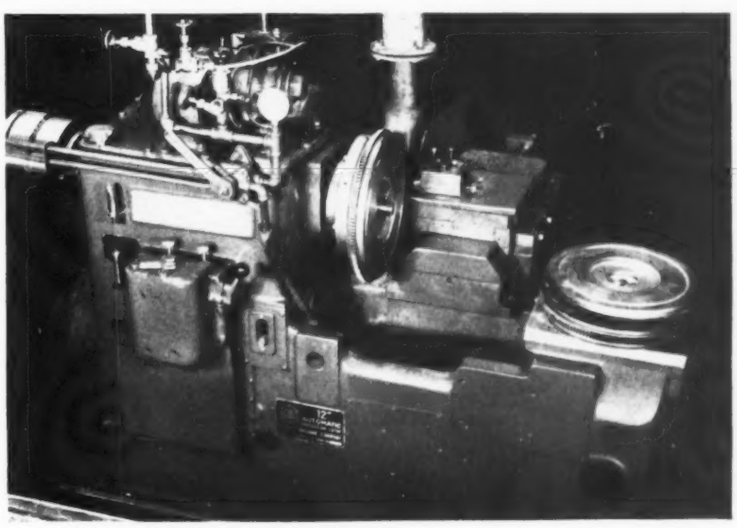


Fig. 4. A Constant Cutting Speed is Maintained in Facing Flywheels on This Machine by the Use of a Variable-pitch V-belt Drive

Automatic Gas Furnaces

Furnaces with Controlled Gas Fuel Supply, Automatically Synchronized with Other Production Equipment

By J. B. NEALEY
American Gas Association

AUTOMATIC furnaces for heating machine parts, synchronized in the production line with the machine tools and other production equipment, are among the new developments in industry. The manufacturer may specify the quantity of parts requiring heat-treatment, time and temperature requirements, grain structure desired, etc., and an automatic gas furnace can be designed to meet these specifications and set up right in the production line. Such an installation has been made in the spring plant of the Forge, Spring, and Bumper Division of the Chevrolet Motor Co.

Chevrolet flat and coil springs and bumpers are made in one long building, with collecting and assembly conveyors of the slat type running down both sides of the building, close to the walls. Between these conveyors are a number of large continuous automatic gas furnaces, to which the steel is fed for heating and from which it is removed for forming.

While several types of steel are used in leaf spring manufacture, the bulk of the 1200 complete leaf springs produced hourly are, in this case, made from S A E-9260 steel. About six cars of steel bars are received daily. They first pass to huge punch presses, which cut the steel to spring lengths, punch the holes, crop the ends, and discharge them on the collecting conveyors, which carry them past drill presses and other machine tools to the gas-fired hardening and forming furnaces.

Some of the steel bars, however, are first heated for eye-forming in twin slot type gas furnaces which face each other, with the conveyor between them. The steel bars are carried along at a predetermined speed, each end protruding through a slot into the furnace. After the ends have been heated, the bars are successively forced into an eye-forming machine, and they are then replaced on a conveyor which carries them to the forming and hardening furnaces. The steel for the rear springs travels down one side of the shop, while that for the front springs goes down the other; both groups cross over to opposite sides of the shop

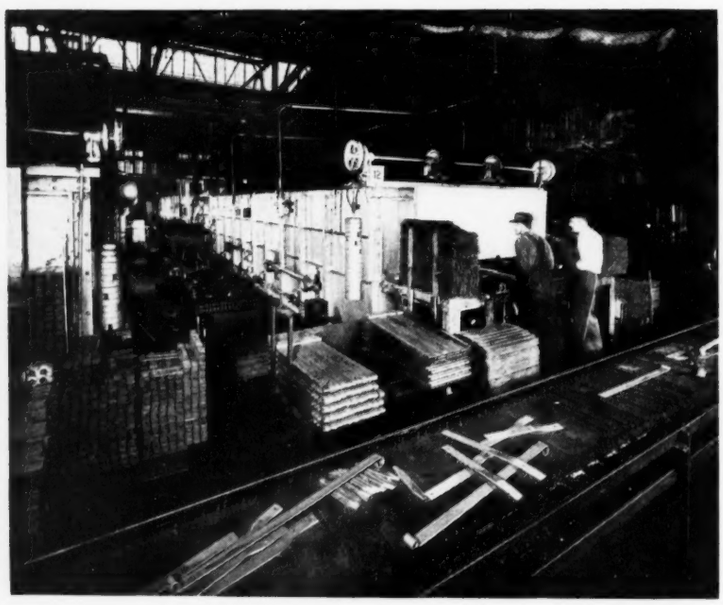


Fig. 1. One of the Nine Heat-treating Units for Leaf Springs in the Chevrolet Spring Plant, Each Consisting of a High-heat Furnace in Foreground, Quenching and Cambering Machine, Drawing Furnace, and Cooling Tank

for Chevrolet Springs

Fig. 2. Steel Heated in Gas Furnaces is Formed Hot in This Machine, which then Lowers the Formed Spring into a Tank of Oil for Quenching

as they pass through the combination heat-treating and cambering furnaces.

There are nine heat-treating and forming units, each consisting of a high-heat furnace and a draw furnace, set in tandem, with a cambering machine and quench between them. All these furnaces are continuous in operation and automatic as to temperature control. The high-heat furnaces are each 32 feet long and 10 feet wide, and are equipped with mechanical pushers. On the hearth of each furnace are laid from four to eight rails, according to the type of spring to be moved through it.

The bottom space of the furnaces is divided into seven combustion chambers by refractory cross-walls. These walls also serve as supports for the solid hearth and rails. A small space is left open at each side between the hearth and the furnace wall. The hot products of combustion, after traveling across the combustion chamber, rise through these openings into the heating chamber at one

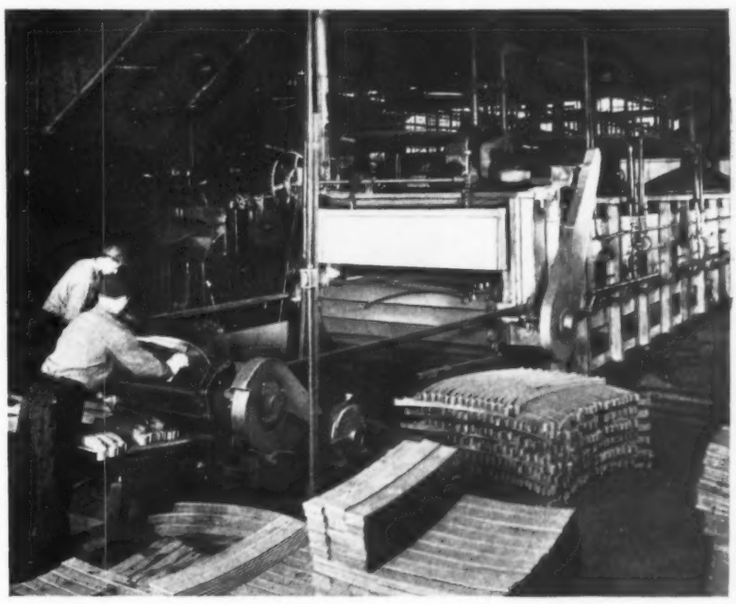


Fig. 3. View Showing Discharge End of Gas-fired Drawing Furnace, with Springs Dropping into a Water Tank for Cooling. The Flight Conveyor Seen in the Foreground Removes the Springs from the Cooling Tank

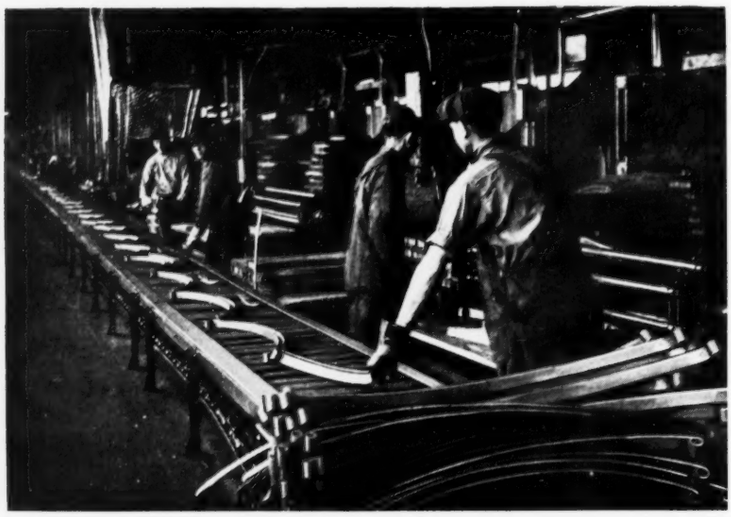


Fig. 4. Sorting the Spring Leaves and Loading Them on the Collecting Conveyor

side, travel across the furnace and work, and return to the combustion chamber or are exhausted on the opposite side. The gas burners are staggered on each side of the furnace, so that the flow of heat in alternate sections is in opposite directions. This promotes even temperature distribution.

Gas Economy through Recirculation

Exhaust flues are built into the furnace walls just above the gas burners. A part of the waste products of combustion is thus exhausted to the atmosphere, while the other part is reheated and recirculated. The opening in the hearth on the burner side is so designed that the firing of the burner below sets up a draft that effectively draws some of the burned gases from the heating chamber down into the combustion chamber. By the use of dampers, any desired proportion between exhaust and recirculated gases can be maintained.

Two blowers furnish air at 1 1/2 pounds pressure to all the burners. Zero governors are provided to reduce the gas to atmospheric pressure. Single burners or groups of burners on manifolds are equipped with Venturi tubes, and through these the air is made to inspirate the gas in any desired proportion. The air lines all run through a central control room and thence to the blower. A valve is cut into each air line in the control room and is connected to an automatic temperature controller, which, in turn, is actuated by a thermo-couple in the furnace. Each controller is also connected to a recording pyrometer. In this way, the thermal condition of every furnace is under the direct supervision of the chief metallurgist.

The conveyor system for this type of furnace is rather unique. The rails in the furnace are U-shaped, and short tubes and pins on which the work rides are moved along by the mechanical pusher. To eliminate handling of these pins or tubes, an automatic system was installed which includes another set of U-rails just below the first. As the tubes reach the discharge end and the work is removed, they drop into the lower U-rails and are pushed back to the charging end mechanically. At the charging end, a small elevator raises them to the level of the upper U-rails where they are loaded with work, ready for the main pusher.

Slat Type Conveyors for the Drawing Furnaces

As the hot steel is discharged from the furnace, an operator picks it up with tongs and inserts it between the dies of the cambering machine. This machine has eight sides, with a set of dies on each side. The dies are closed by pneumatic pressure to produce the right form for the springs. The machine is partly submerged in a tank of oil, and as soon as the steel is formed, it is revolved through the oil for quenching. Another operator transfers the leaf to one of nine gas-fired drawing furnaces, which are exactly like the high-heat furnaces, except that they are 10 feet longer and are equipped with slat type conveyors instead of mechanical pushers. The combustion and temperature control systems are identical.

The steel remains in the first furnace for twenty-two minutes. It is quenched at from 1550 to 1600 degrees F., and remains in the drawing furnace

for eighty minutes, where it is heated to 975 degrees F. This gives the finished leaves a Brinell hardness of from 364 to 444.

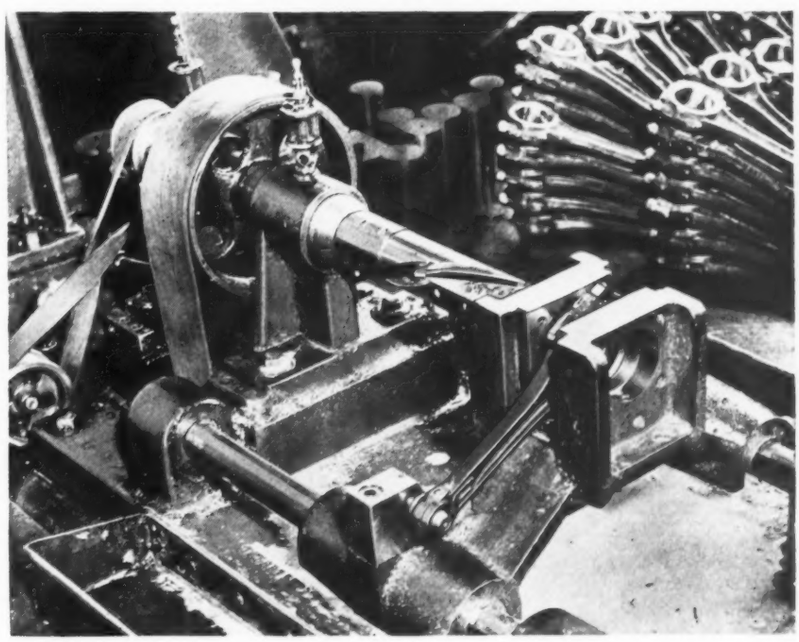
The complete spring assemblies are made up, clips riveted on, bushings inserted, and broached on the collecting conveyor. The springs are then transferred to the assembly conveyor, which is simply an extension of the collecting conveyor. Here the grease is sprayed on, the bolt inserted in the center ball hole, and a nut put on; the clips are also clinched on in a pneumatic machine. A hydraulic bulldozer then "reverses" the spring and sets it at the proper height. The springs are now ready for their final test and inspection.

Reaming 600,000 Babbitt Bearings between Grinds

THE final operation on the babbitt bearing in the crankpin end of Buick connecting-rods consists of sizing and finishing with a single-blade angular reamer. This operation brings the bearings to size within a tolerance of 0.0003 inch, the maximum and minimum dimensional limits for the diameter being 2.0000 and 2.0003 inches.

In addition to accuracy, an unusually high finish is obtained, the reamer blade being tipped with tungsten carbide. Another important advantage derived from the use of tungsten carbide is that 600,000 bearings are reamed, on an average, per sharpening of the blade. When the blade was made of high-speed steel, the production between grinds was only 1000 connecting-rods, and the blade had to be honed after every twenty-five or thirty rods. It is never necessary to hone the tungsten-carbide blade. The blade is 4 inches long, and it has an angle of 20 degrees with the axis.

For this single-blade reaming operation, which follows a conventional reaming operation in which an expansion type of tool is used, the connecting-rod is placed in a fixture with the wrist-pin bearing located over a plug, as shown in the illustration. The opposite end of the connecting-rod floats between finished faces of the fixture, while the fixture and work are fed by hand along the reamer. The fixture is guided by a cylindrical bar on each side of the machine. The reamer is run at about 200 revolutions per minute, and soluble oil is used as a coolant. The reamer body is chromium-plated to give long life.



Reamer with a Single Angular Blade of Tungsten Carbide, which Finishes 600,000 Babbitt Bearings of Buick Connecting-rods between Grinds

EDITORIAL COMMENT

A correspondent recently wrote us, expressing concern over the continued use and installation of improved manufacturing machinery and intimating that he fears that the use of such machinery will result in increased unemployment.

As has been pointed out in MACHINERY in editorials and other articles for several years, there is no evidence to the effect that improved machinery is the cause of unemployment. On the contrary, the evidence is all the other way. Improved machinery makes it possible to produce things that people want and need at lower costs than those at which they formerly could be produced. This increases the market for the goods manufactured, widens the demand for labor to meet the greater demand for goods, and makes possible the raising of wages because of the greater production at lower cost per piece.

An Old Fallacy that Appears to Die Hard

Take, for example, the automobile industry. How many men would have been employed in that industry today, compared with, say, thirty years ago, if the general type of standard machines then in use were still employed in the automobile factories? The automobiles of today—granted that they even could have been built by the machinery available in 1908—would have been so costly that only the very well-to-do could have afforded to buy them. As a result, there would have been nowhere nearly as many people employed in building automobiles today as there now are, because the business would have been purely a luxury industry.

But due to improved manufacturing machinery, the automobile is no longer considered a luxury of the rich. There are a hundred inexpensive cars built for every one that may be considered a wealthy man's luxury. To manufacture these cars, nearly 500,000 people are directly employed in automobile and parts factories, and, in addition, about 5,500,000 people are employed in repair and service stations, as truck and bus drivers, in petroleum refining, and in roadbuilding—all due directly to the use of improved machinery in building automobiles.

Millions Employed Because of Improved Machinery

It is obvious to even the most superficial observer that, in this industry, improved machinery has vastly increased employment. A similar analysis of any other industry where improved machinery has been used to a large extent to increase production would lead to the same conclusion.

Again, the effect of improved machinery on wages should not be overlooked. In the days of comparatively crude machine equipment in the industries—thirty, forty, or fifty years ago—wages were much lower than they are today. In fact, wages for comparatively unskilled labor were unbelievably low judged by today's standards. Improved machinery has had much to do with the possibility of increasing wages and of placing within the reach of wage-earners many things that in the earlier days were luxuries for the few.

Equally important has been the effect of improved machinery on working hours. Those of us who are middle-aged still remember having worked ten hours a day, five days a week, and nine hours on Saturday—fifty-nine hours a week in all. Today, the forty-hour week is established in American industry. Yet, *because of the productivity of improved machinery*, forty hours of work per week actually provide a higher standard of living than the much longer hours of past years.

"Leaders" Needed to Keep Pace with the Engineer

It is obvious to those who have given the subject serious thought that unemployment is due to causes other than improved machinery. One comes to the conclusion that political leaders, as well as labor leaders, who ought to have studied these causes, have lagged behind our engineers in progress and development. Political and labor leaders are inclined to live in the past century, without taking advantage of the tremendous opportunities for progress and well-being of the people as a whole that the work of the engineer in developing improved machinery and methods has made possible. Unemployment will never be overcome by the methods now proposed by the Government or by labor leaders. Somehow their policies remind one of the days when medical men knew of no better method to combat illness than by "letting blood," which weakened the patient instead of strengthening him.

What we need is not an effort to hold the engineer back while other professions catch up with him, but rather an effort to speed up the "leaders" in other branches of our national life, so that their work and thought may keep pace with the progress of engineering and industry.

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Mechanism for Converting Rotary into Reciprocating Motion and a Single-Chain Differential Drive

By ADOLPH MOSES

The mechanism shown in Fig. 1 is used for converting rotary into reciprocating motion. It can be designed to give various ratios of strokes to revolutions and to cause the phase of the reciprocating motion to vary continuously with respect to the rotary motion. Such variation is desirable for lapping and polishing. For example, it can be built to have sleeve T make 0.565 reciprocation per revolution of sprocket C. The reciprocating motion is continuous and positive and takes place without shock.

The stationary housing K supports a bushing D, held in place by a screw E. The shaft A rotates in bushing D and is restrained from endwise motion by the hub of sprocket C and the base of the truncated cylinder F. At L is another truncated cylinder similar to the one at F. These cylinders are keyed to shaft A with their truncated faces parallel and spaced by the sleeve J. The nut M serves to clamp the members F, J, and L together.

Sleeve T is a sliding fit in housing K, and is restrained from rotating by the key S. The internal collar or race G is held in sleeve T by the snap-ring H. In dismantling, the snap-ring may be reached through the holes in sleeve T. The two balls O are positioned by the ball cage N which straddles the internal collar G, so that the line joining the ball centers is parallel to the axis of shaft A. The cage N bears on the faces of the collar or race G and thus holds the balls in line.

Rotation of driving sprocket C rotates the truncated cylinders or face-cams F and L, thus causing the balls O to roll on the cam surfaces and on the internal collar G which they cause to reciprocate or shift from side to side. The reciprocating motion is transmitted from collar G to sleeve T through ring H.

If the faces of collar G were not grooved but constructed with two plain surfaces, the balls and their cage would make one revolution about the axis of shaft A to every two revolutions of shaft A. This gives two revolutions of A for each complete reciprocation of sleeve T. With the faces of the collar G grooved as illustrated, however, the ratio is somewhat different, as shown by the equation:

$$\frac{\text{Number of reciprocations of } T}{\text{Number of revolutions of } A} = 1 - \frac{P}{R}$$

It is not necessary to groove the faces of collar G in order to get a varying-phase relation between A and T. Any creep of the balls or the collar itself, however little, will cause a continuous though slight change in the phase relations. The ratio of revolutions of the driving sprocket C to the num-

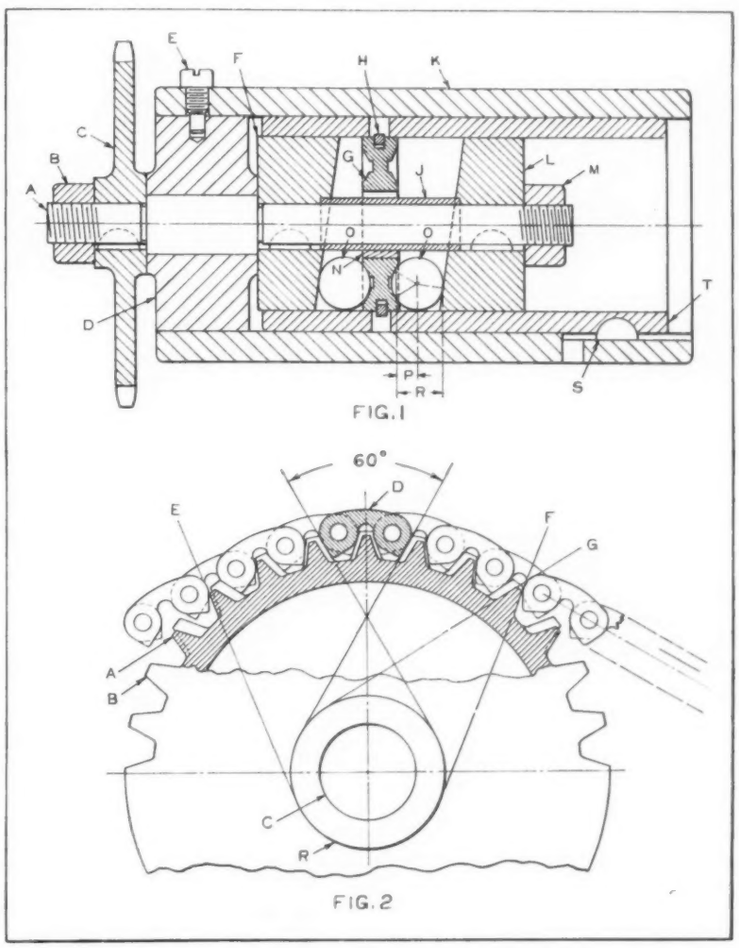


Fig. 1. Mechanism for Converting Rotary into Reciprocating Motion
Fig. 2. Single-chain Differential Drive Applied to Mechanism Shown in Fig. 1

ber of strokes of sleeve *T* can be further modified by mounting housing *K* so that it can be rotated about the axis of shaft *A*. The chain mechanism shown in Fig. 2 provides a convenient means for driving shaft *A* and housing *K* at slightly different speeds. Ordinarily, two concentric sprockets would be driven by two separate chains, each with its own take-up mechanism. The mechanism shown in Fig. 2, however, drives the two concentric sprockets at slightly different speeds by means of a single chain which is wide enough to engage both sprockets. Referring to Fig. 2, *B* is a standard sprocket and *D* a silent chain. The special sprocket *A* has one tooth less than sprocket *B*, but has substantially the same outside diameter and root diameter as sprocket *B*. Its teeth are cut with the same cutter as is used for sprocket *B*, but the sprocket is indexed and recut to make the tooth thickness less than normal, so that the teeth *A* do not interfere with chain *D* and lift it off sprocket *B*.

The approximate tooth outline can be determined as follows: Draw the circle *R* tangent to the 60-degree faces of the standard gear tooth, and also draw a standard chain in contact with sprocket *B*, making the angle of wrap as small as possible without sacrificing proper functioning of the driving chain. Next, draw the line *E* tangent to the circle *R* and to the chain tooth which is about to engage the standard sprocket *B*. This establishes the driven face of the sprocket tooth on sprocket *A*. Next draw line *F* tangent to circle *R* and to the chain tooth that has started to leave the standard sprocket *B* to establish the opposite face of a tooth on sprocket *A*. Draw the line *G* tangent to the circle *R* and a whole number of tooth spaces from the line *E*, as measured on sprocket *A*. The space included between *F* and *G* will be the approximate tooth on sprocket *A*. It may be easier to place a chain on the sprockets and cut the teeth of the second sprocket back by trial cuts until there is no interference than it is to lay out the tooth as described.

The operation of the mechanism is as follows: The chain, coming in wedge-like contact with a tooth of sprocket *A* along the line *E*, moves sprocket *A* a little faster than sprocket *B*. The narrow teeth on sprocket *A* permit it to move faster than sprocket *B* without interfering with the chain. One tooth at a time on sprocket *A* takes all the drive. If necessary, these teeth can be made shorter than standard teeth, as shown in the illustration.

The sprocket *A* shown in Fig. 2 has 27 teeth, while the sprocket *B* has 28 teeth, so that the relative speeds of the two sprockets are inversely proportional to their number of teeth.

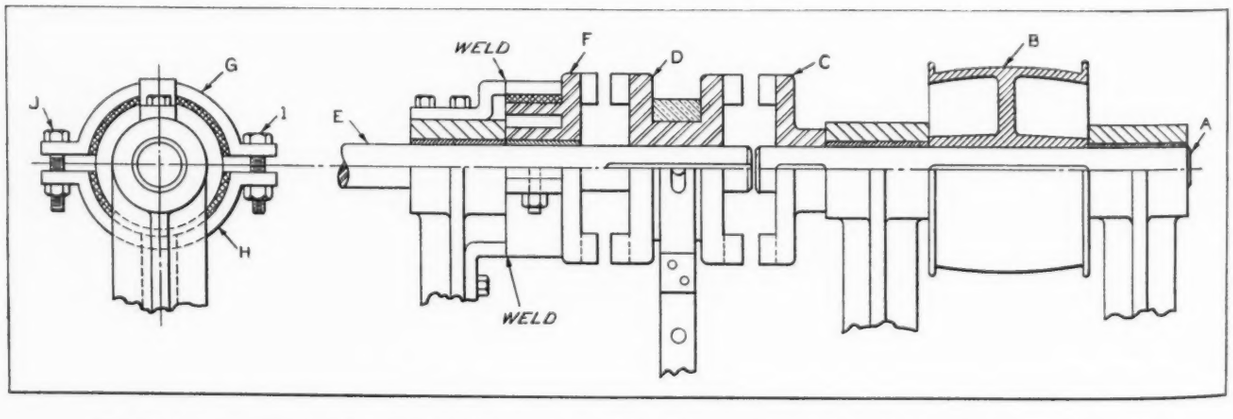
In using the single-chain differential drive on the mechanism shown in Fig. 1, the standard tooth sprocket *B* was used to drive the housing *K*, which should be mounted so that it can rotate but is restrained from endwise movement, while the special 27-tooth sprocket *A* took the place of sprocket *C*. Thus when housing *K* and collar *G* have made 27 revolutions, the cams *F* and *L* will have made 28 revolutions. The cams, therefore, gain one revolution on collar *G* for each 27 revolutions of the housing. Since it requires approximately two revolutions of the cams with respect to collar *G* to produce one reciprocation, it will require 2×27 or 54 revolutions of housing *K* to produce one reciprocation when the collar *G* has plain faces. The sleeve *J* may be omitted and the nut *M* pulled up until the balls just grip collar *G*. The nut can then be locked with a cotter-pin or check-nut. A light spring could be used under the nut *M*, but this was not found necessary for the particular mechanism shown.

Care should be taken not to make the angle of the truncated face of the cylinders *F* and *L* too large. The limiting angle may be found by experimenting with a ball placed between two lubricated surfaces. The angle used for the mechanism shown was 8 1/2 degrees. This angle was found satisfactory when using balls 3/8 inch in diameter.

Clutch Equipment for Quick-Acting Brake

By RAYMOND O. KRENGEL

The quick-acting brake in the double-ended jaw clutch shown in the accompanying illustration was designed to permit the sudden stopping of a certain shaft *E* used for winding metal strip. The driving shaft *A* is rotated continuously by a belt on the



Clutch Arrangement for Disengaging Shaft E from the Driving Shaft A and Applying Brake to Shaft E

pulley *B* to which it is keyed. The double-ended clutch jaw *D* is free to move endwise along shaft *E* and slide along a key which compels it to revolve the shaft when engaged with the driving member *C*.

When jaw *D* is disengaged from member *C*, it engages the member *F*, which also acts as a brake-drum. Brake-shoes *G* and *H*, being tight at all times, will stop shaft *E* quickly upon the engagement of clutch *D* with member *F*. The brake-shoes are kept tight by means of bolts *J* and *I*. They are fastened to the bearing stand, which prevents them from turning. The brake linings are of standard width and can easily be replaced when worn out.

Rack and Intermittent Gear Mechanism for Obtaining Uniform Reciprocating Motion

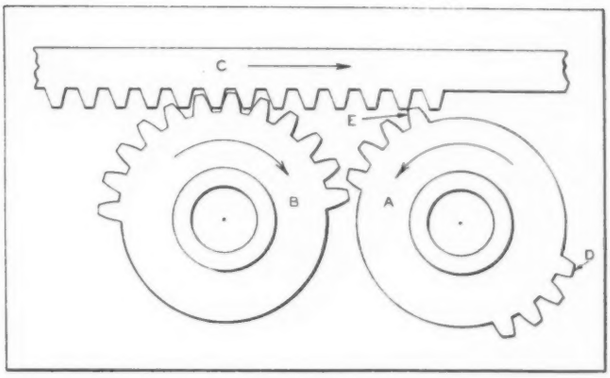
By L. KASPER

The reciprocating motion produced by the experimental mechanism shown in the accompanying illustration differs from that of the crank-driven movement so commonly used, in that member *C* moves at a uniform speed or velocity on both the forward and reverse strokes. No sliding gears or clutches, such as are usually employed in gear-driven reciprocating motions, are used in this mechanism.

Referring to the illustration, the intermittent driving gear *A* rotates constantly in the direction indicated by the arrow. The teeth of gear *A* mesh alternately with the teeth of rack *C* and gear *B*. In the position shown in the illustration, the leading tooth on gear *A* is about to make contact with the first tooth of gear *B*, causing the latter to rotate in the direction indicated. The motion of gear *B* is transmitted to the rack *C*, causing it to move to the right.

As the last tooth *E* in gear *A* completes its contact with the mating tooth in gear *B*, the tooth *D* in gear *A* is ready to engage the mating tooth in rack *C*. When this occurs, the direction of movement of rack *C* is reversed. At this point, the teeth on gear *B* are in the clearance space of gear *A*. Gear *B* is then driven by rack *C* until tooth *D* of gear *A* meshes with gear *B*. The alternate driving of rack *C* by gear *A* and gear *B* produces a uniform reciprocating motion of the rack.

It will be noted that the number of teeth in each tooth section of gear *A* is two less than one-quarter of the number of teeth that would be carried by a full gear of the same size and pitch. Although this is necessary to prevent clashing, the effect is the same as that produced by a quarter turn of a gear having the full number of teeth. It will also be noted that the two end teeth in each toothed section of gear *A* are modified to provide sufficient clearance to permit the reversal of rack *C*. On large gears, it will be necessary to modify the succeeding tooth as well. Also, it may be necessary to remove a small amount of material from the leading face



Mechanism for Transmitting Uniform Reciprocating Motion to Rack C from Rotating Intermittent Gear A

of the leading tooth in each group of teeth in gear *A* to permit a slight lag in the reversal of rack *C*. The degree of modification of the teeth necessary for the proper functioning of the mechanism will vary with the size of the gears and their pitch.

The length of travel of rack *C* is determined by the diameters of gears *A* and *B*. The number of teeth in these gears must be divisible by 4. Although this mechanism can be used only where moderate speeds are employed, due to the necessity for suddenly arresting the momentum of rack *C* and gear *B*, its simple construction recommends its application wherever the speeds are within the permissible range.

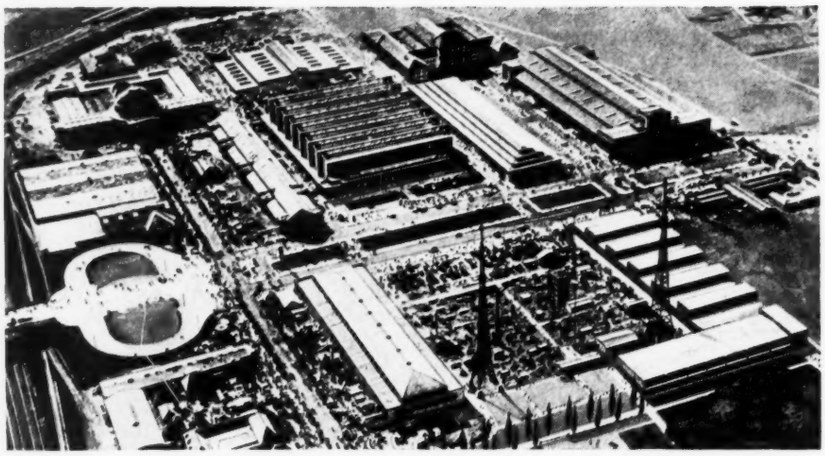
* * *

Protection for Workers' Hands

A protective cream has been developed by the Davis Emergency Equipment Co., 55 Vandam St., New York City, for use by workers whose hands come in contact with chemicals, solvents, grease, oil, gasoline, or similar substances. This cream is rubbed on the hands and on the arms, if necessary, before starting work. It forms a non-sticky film which protects the skin. Since this cream is not effective against water and aqueous solutions, it can be washed off easily at noon time or at night, all the grease, paint, dirt, lacquer, etc., being removed with it, so that the hands are left smooth and clean. Another cream has been developed by the same company for use by those whose hands are frequently wet with water or aqueous solutions.

* * *

When platinum was discovered by the Spaniards in 1538 in what is now Colombia, South America, it was thought to be of no value. It was called "platina," meaning "little silver." The explorers sent samples home to the King of Spain, who conceived the idea that since the platinum was found with gold in the river sands, it might grow into gold if soaked longer in the same water; so he ordered that the metal be returned to the river for further treatment.—*White Metal News*



Aerial View of the Buildings and Grounds Devoted to Machinery and Engineering Exhibits at the Leipzig Fair in Germany

The Leipzig Machinery Exhibition

THE well-known annual machinery and engineering exhibition at Leipzig, Germany, was held this year March 6 to 14. While the Leipzig Trade Fairs have been held in that city for 700 years, it is only for the last twenty-five years that the machinery and engineering fair has been a division of the Trade Fair. During this period, however, it has grown to very large proportions.

This year the fair had more than 2500 exhibitors of machinery and equipment for every industry and for every conceivable purpose; over 5000 machines were shown in operation. While, obviously, the great majority of the exhibitors were German firms, the exhibition was, nevertheless, truly international in character in that some twenty-five different countries were represented among the exhibitors.

An important part of the machinery exhibition was the section representing machine tools and shop equipment, in which there were more than 400 exhibitors, occupying the large main hall regularly assigned to the machine tool exhibits, and, in addition, another building devoted exclusively to machine tools and shop equipment. One part of the additional building was devoted to products of companies outside of Germany, this section having over fifty firms represented, primarily Austrian, Swedish, and Swiss machine tool builders.

The illustration above gives an idea of the number of buildings devoted to the various machinery and engineering exhibits, while that on the next page shows the well-known Hall No. 9, which is the main exhibition hall devoted to machine tools. There is a separate exhibition building for each one of the following industries or groups of exhibits—twenty large halls in all: Industrial and factory supplies; engineering materials; industrial patents; electrical engineering and machines (two buildings); machine tools (two buildings); office machines; machines for the chemical and food industries; textile machines (including sewing and laundry machines); woodworking machinery; motorcycles, bicycles and accessories; building engineering and building materials (two buildings);

A View of One of the Aisles in the Spacious Machine Tool Exhibition Building

The Well-known Hall No. 9 at the Leipzig Fair, the Main Exhibition Building Devoted to Machine Tools and Shop Equipment

heating and air-conditioning equipment; power plant engineering; machines for the book and printing trades; and structural steel. In addition, there were open-air exhibits of outdoor conveyors, tractors, compressors, excavators and road-building machinery, locomotives, building equipment, and similar equipment.

It is estimated that the fair was attended by nearly 300,000 people, of whom some 35,000 were visitors from abroad. In coming numbers of MACHINERY, some of the more unusual machine tool developments at the exposition, as seen by the editor of MACHINERY, who visited the exposition, will be referred to.

The Conference Method of Foremen Training

IN a report of the Committee on Vocational Education of the Associated Industries of Cleveland, it is emphasized that modern industrial progress has vastly increased the responsibility of the foreman. Today it is essential that the foreman not only have a clear understanding of the work that is to be performed under his direction, but that he also understand the reason behind orders he receives from his superiors and that he be able to explain these reasons to the employes.

The foreman must possess a thorough knowledge of the attitude of his company toward its employes if he is to fulfill properly what is today one of his most important functions—maintaining sound relations between management and men. Those who have inquired into the methods by which the foreman can secure such training and knowledge as is necessary to fulfill his duties properly, have come to the conclusion that the "conference method" of foremen training will most effectively bring about the desired results. This method has proved to be the most effective medium by which:

1. To give the executive and supervisory forces a knowledge of company organization.
2. To give instruction in company policies and the opportunity to analyze and discuss their operation.
3. To insure a clear understanding of departmental responsibilities and functional procedure.
4. To make clear the inter-relationships of the executives and supervisory personnel.
5. To stimulate constructive and cooperative thought on company problems.
6. To secure for management, from the supervisory group, an analysis of operating problems with suggested solutions.
7. To instruct the executive and supervisory personnel in the proper analysis of their own jobs.
8. To convey to foremen sound information on the industrial, economic, and social aspects of labor relations as they affect the company, the employe, and society.

* * *

The Machine-Building Industry in the Soviet Union

According to the *U.S.S.R. Monthly Review*, the output of the machine-building industries in the Soviet Union has increased more than tenfold from 1928 to 1936. Before 1918, the machine-building industry in Russia was negligible. The production was not more than about 6 per cent that of Germany, 10 per cent that of Great Britain, and 4 per cent that of the United States. From 1929 onward, there has been a radical change in world production of machinery, and especially in Soviet production. In 1934, the volume of Soviet machine building had exceeded the machine-building production in Great Britain. The maximum output of the German industries is also said to have been exceeded. If the motor vehicle industry is excluded, the Soviet machine-building industry in 1936 reached a point where it was exceeded only by the United States, which produced 40 per cent more machinery.

Die Design and Construction

A Treatise on the Principles Embodied in the Design of Different Types of Sheet-Metal Blanking, Forming, and Drawing Dies — Third of a Series of Articles

By CHARLES R. CORY*

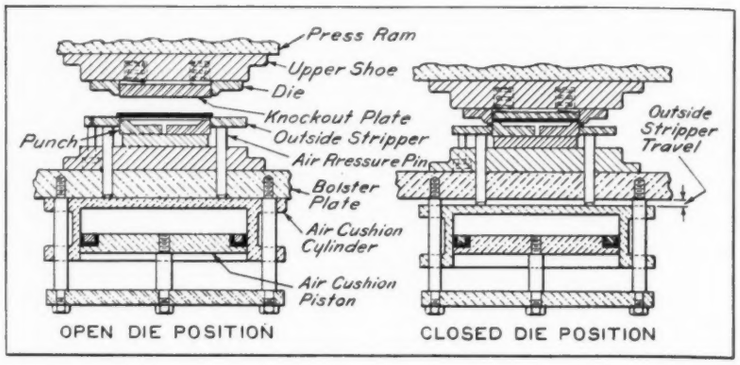


Fig. 2. Air-operated Pins and Stripper Plate for Stripping the Stock

THE previous installments of this series of articles, published in February and March MACHINERY, dealt with the drop-through type of blanking die. This article will discuss the "return" type, which differs from the drop-through type in that the location of the punch and die is inverted, the punch being below and the die above. The blank travels up into the die opening.

Fig. 1 shows a typical die of the return type. The arrangement of the outside stripper, which strips the stock from the punch on the up stroke of the press, and of the knock-out plate, which is required to strip the blank from the die opening, will be noted in this illustration. The drop-through type of blanking die does not require a knock-out plate, since the blank continues down through the die opening and, consequently, does not have to be returned or stripped.

*Die Engineer, Fisher Body Division, General Motors Corporation, Detroit, Mich.

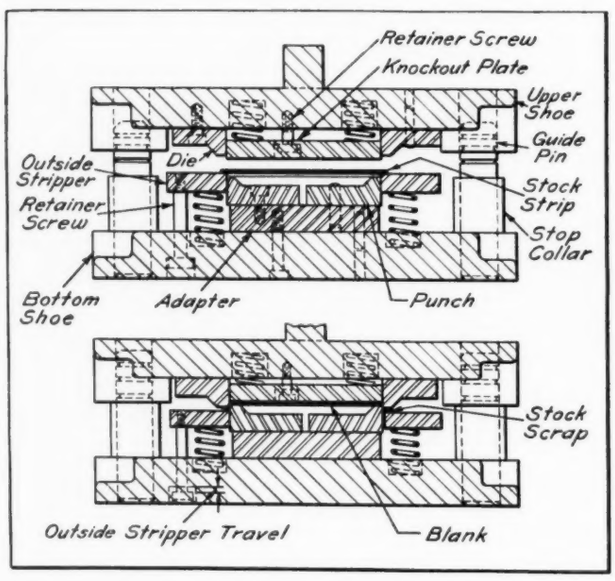


Fig. 1. Typical Blanking Die of the Return Type

In the return type of die, on the down stroke, the die comes in contact with the stock strip, which is supported on the spring- or air-operated outside stripper. As the die travel continues, the die forces the stock strip and stripper downward, compressing the stripper springs. The punch, located below, then shears through the stock strip and forces the blank up into the die opening. If the knock-out plate in the die opening is spring-operated, the springs are compressed.

On the up stroke, the upward movement of the die permits the springs (or in some constructions the air pressure) under the outside stripper to force it upward. This motion strips the stock from around the punch. At the same time, the spring pressure above the knock-out plate keeps the blank in contact with the top surface of the punch, thereby stripping the blank out of the die opening.

A return type die is used only if a drop-through type is impracticable. The return type is more expensive to build and is slower in operation for the reason that the operator must remove a blank from the die at each press stroke, instead of removing twenty or more blanks at a time.

The Outside Stripper

The outside stripper plate can be operated either by springs or by air pressure. When the die is in an open position, the outside stripper supports the stock strip slightly above the top surface of the punch. During the down stroke, the stripper is forced down around the punch, ready for stripping the stock on the up stroke.

Air-operated pins can be used if the die operates in a press equipped with an air cushion plate below the bolster plate of the press. The cushion plate is operated vertically by the action of air cylinders, as shown in Fig. 2. The air pins extend from the stripper plate down through the lower shoe and bolster plate to the air cushion plate. When the die is in the closed position, the air pins usually extend below the bottom surface of the bolster plate a

distance equal to the necessary travel of the stripper plate. On the up stroke of the press, the pins will be pushed up by the air cushion plate flush with the bottom of the bolster plate.

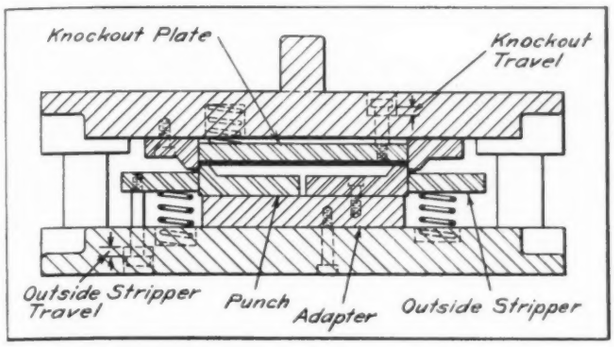


Fig. 3. Die with Direct Spring Knock-out of Typical Construction

Large presses are often equipped with more than one air cushion plate, each of which may be operated by more than one air cylinder. Small presses may have spring cushion plates resembling the air cushion plates, except that they are operated by very powerful springs.

The stripper is usually made of cold-rolled steel or boiler plate and has the gages attached to it. It is attached to the lower shoe by retainer screws. If the stripper is spring-operated, the retainer screws limit the stripper travel so that the stripper will normally be located slightly above the top surface of the punch, at which time the springs still should have about 1/4 inch initial compression. If the stripper is air-operated, the retainer screws should not limit or stop the stripper travel, because in that case, the air pressure would be acting on the heads of the retainer screws. Instead, the stripper travel is limited by the air pin travel, and the retainer screws only serve to prevent the stripper from falling off if the die is turned upside down when out of the press.

The Knock-Out Plate

If the knock-out plate is operated by springs, they are obviously compressed when the die moves downward around the punch. During the first part of the up stroke, the knock-out plate keeps the blank in contact with the punch until the blank has been stripped from the die. At that time the knock-out plate retainer screw-heads should be in contact with the bottom of their counterbores. During the remainder of the up stroke, the knock-out plate protrudes slightly below the bottom surface of the die proper.

If the knock-out plate is operated by positive action rather than by springs, the blank stays in the die opening. It travels upward until close to the end of the up stroke of the press. At that time the further upward travel of the knock-out plate is stopped by some part of the knock-out mechanism striking a stationary part of the press. Since the die continues to travel upward, the blank is stripped from the die opening.

In the case of a spring type knock-out, the blank does not move upward with the die; but since the stock strip is returned to the top level of the punch, the blank will be pressed into the blank hole of the stock strip. With a positive type of knock-out, on the contrary, the blank moves upward and is then knocked out. It may (1) fall on top of the stock strip; (2) be caught by the operator; (3) be made to shed off the die by inclining the press; or (4) be blown to the rear by a jet of air as it falls.

As indicated, the knock-out may be of different types: (1) Direct spring knock-out; (2) single-pin positive knock-out; (3) four-pin positive knock-out; (4) press bar knock-out; (5) pull-down bar knock-out; and (6) indirect spring-operated knock-out.

Direct Spring Knock-Out

The direct spring knock-out is the simplest type, a typical construction being shown in Fig. 3. The retainer screws are of such length that the springs will have sufficient initial compression when the die is in the open position. The retainer screw heads bottom on their counterbores when the knock-out plate is flush with, or slightly below, the surface of the die proper. If there is not enough space for the necessary number of springs, this type of knock-out cannot be used.

The springs, when compressed to the closed die position, should provide a stripping pressure in pounds determined by the formula:

$$\text{Stripping Pressure} = \text{Length of Blank Outline} \times \text{Thickness of Metal} \times 2500$$

During the time that the knock-out plate is strip-

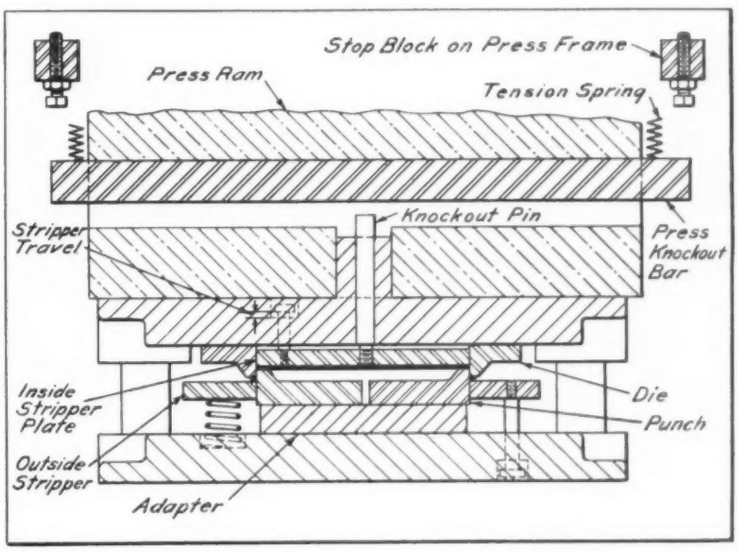


Fig. 4. An Arrangement of Single-pin Positive Knock-out

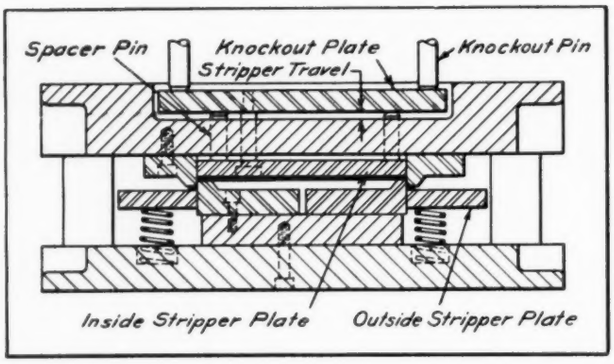


Fig. 5. Die Design with Four-pin Positive Knock-out

ping the blank from the die opening the outside stripper has returned the stock strip flush with the top of the punch. The blank, therefore, is back in the hole in the strip from which it was blanked and is then shaken from the stock strip as it is fed through the die. When the stock strip is wide, this may require an extra operator at the rear of the press. In many cases, where the stock strip is heavy, this extra operator is required to handle the stock scrap, even if he is not needed for the blank disposal.

A spring knock-out is often used if there is room above the knock-out plate for as many springs as are necessary. It is self-contained, and the die is easy to set up in the press, as well as suitable for any press that has the required shut height. It has the disadvantage of being somewhat slower in operation than a positive return knock-out, since the blank is pressed back into the stock strip instead of falling on top of it, at the top of the up stroke.

Single-Pin Positive Knock-Out

The single-pin positive knock-out is used for small blanks. A knock-out pin, as shown in Fig. 4, is attached to the knock-out plate, and extends up through the upper shoe shank to the positive knock-out bar of the press.

On the down stroke of the press the knock-out plate is loose, except for the retainer screws, and extends slightly below the bottom surface of the die proper, traveling up in the die opening with the blank. On the up stroke of the press there is no knock-out action until the upper shoe is close to the top of its stroke. The knock-out action starts at a distance below the open position of the die equal to the amount of travel necessary for stripping the blank. At that time, the knock-out pin strikes the knock-out bar of the press, so that the knock-out plate cannot travel upward any farther, although the upper shoe does. The blank is, therefore, stripped from the die and falls on the stock strip. Retainer screws prevent the knock-out plate from falling out of the die.

The limitation of the use of this type of knock-out is the size of the blank. If the blank is large, the knock-out plate will tend to tip and break off the knock-out pin. It is very difficult to select the correct theoretical center of stripping resistance of complicated shapes so as to assure that there will be no tendency to tip. Irregularities of stripping resistance will also result from variations in the dullness of the die edges and in the die clearance at various parts of the blank outline. This type of knock-out can only be used if the die is used in a press equipped with a positive knock-out bar in the ram. In blanking small parts, however, the single-pin positive knock-out is inexpensive and reliable.

Four-Pin Positive Knock-Out

Large presses are often equipped with four knock-out pins, which are fastened to the crown of the press. These pins can be adjusted to project down through the ram, when it is at the top of the press stroke, the amount necessary to knock out the blank.

A knock-out plate in a cored channel at the top of the upper shoe, as shown in Fig. 5, is pushed down by these four knock-out pins close to the extreme top of the press stroke. This movement is transferred to the inside stripper plate by spacer pins, which space the two plates a certain distance apart. The two plates are held together by a single set of retainer screws, or else each plate is attached to the upper shoe by a separate set of retainer screws. A four-pin positive knock-out is used for blanks larger than those suitable for a single-pin positive knock-out, but only if the press is equipped with the necessary knock-out pins.

Press Bar Knock-Out

The press bar knock-out, shown in Fig. 6, operates in a cored channel at the top of the upper shoe and functions close to the top of the press stroke. The bar strikes some stationary part of the press, such as a knock-out block fastened to the press frame at each side of the ram. The knock-out bar stops, but the rest of the die completes its upward travel. This motion of the knock-out bar relative to the die is used to operate the inside stripper plate, the pressure being transferred from the bar to the stripper plate by spacer pins. The knock-out

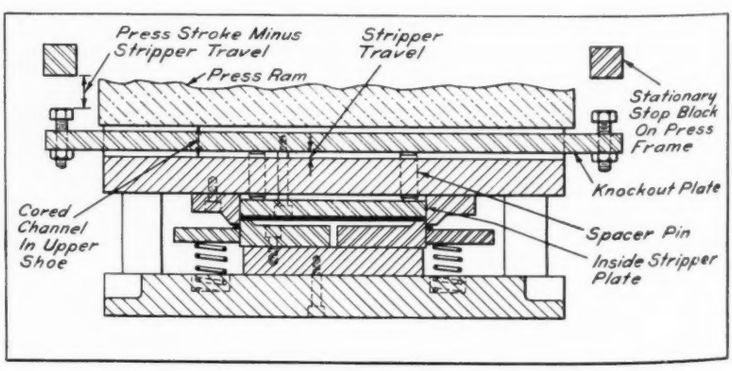


Fig. 6. Typical Press Bar Knock-out

bar and the stripper plate are fastened together with retainer screws. This type of positive knock-out is simple in construction. Since it weakens the upper shoe by requiring a channel through the entire shoe, the latter must be made correspondingly thicker. This knock-out can be used only with certain types of presses equipped with knock-out blocks at the sides of the ram.

Pull-Down Bar Knock-Out

The pull-down bar knock-out, shown in Fig. 7, is a knock-out bar operating in a cored channel in the top of the upper shoe. As the die approaches the top of the press stroke, the upward travel of the knock-out is stopped by the pull-down bolts shown. These bolts must permit a total upward travel of the knock-out bar equal to the press stroke less the distance needed for knocking out the blank.

In order to obtain this travel, it is often necessary to allow the bolt head to stop against a bent steel yoke fastened to the die-shoe. The bolts and yokes telescope into each other to increase the obtainable travel. The pull-down bolts are located so as not to interfere with the stock strip. The movement of the knock-out is transferred to the stripper plate by spacer pins, while retainer screws tie the knock-out plate and the stripper plate together. The knock-out bar should be fairly thick, since the pull-down pressure is at the extreme sides and the stripping pressure at the center.

This type of positive stripper is more expensive than the others, and is therefore used only when the other types cannot be employed. The die cannot be shifted from a press of one length of stroke to a press of another without alteration.

Indirect Spring-Operated Knock-Out

If there is not enough area of knock-out plate for a sufficient number of springs, the springs may be mounted in a cored opening in the top of the upper shoe, as indicated in Fig. 8. The springs bottom on a steel plate attached to the top of the shoe and push against a knock-out plate which can be of any area necessary for the number of springs required. Spacer pins, as indicated in the illustration, transfer the spring pressure on the knock-out plate to the inside stripper plate, the latter being kept from falling out of the die by retainer screws.

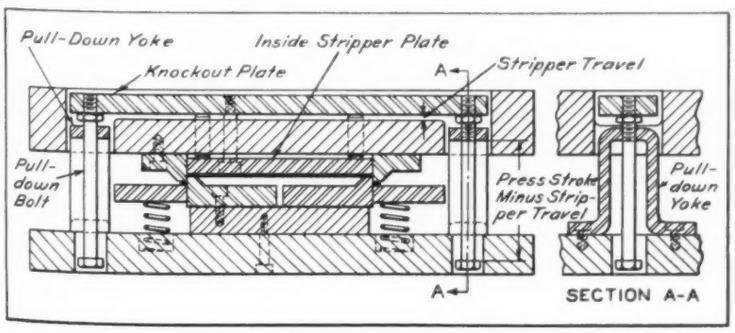


Fig. 7. Pull-down Bar Knock-out

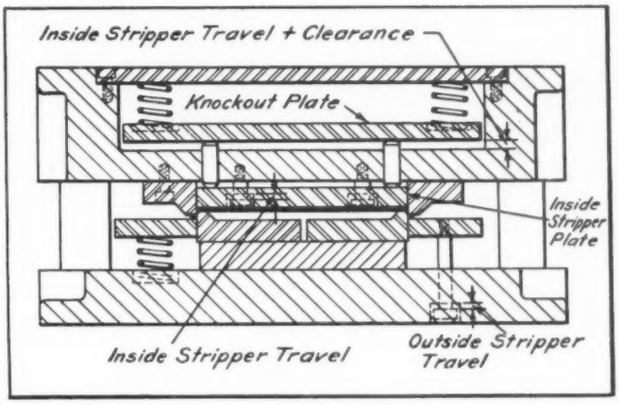


Fig. 8. An Example of Indirect Spring-operated Knock-out

The stripper must clear the upper shoe casting to such an extent that 1/4 inch can be ground off the cutting faces of the die without causing interference. When the die is in the closed position, there should be at least 1/4 inch vertical distance between the inside stripper plate and the upper shoe.

The indirect spring knock-out is ordinarily used only if a direct spring knock-out, or some type of positive knock-out, cannot be used. The indirect spring knock-out is more expensive and requires a considerable shut height.

* * *

Preventing Fires from Being Caused by Welding Operations

In an article in the January number of *Safety*, H. F. Reinhard, secretary of the International Acetylene Association, gives directions for avoiding fires due to carelessness in welding operations. Mr. Reinhard says that the heat from the oxy-acetylene flame rather than the flame itself is usually the cause of fires. The welder is aware that the flame is dangerous and is careful how he uses it, but fires may be started by sparks from the metal being welded or cut, molten slag or metal that falls or drops, or by hot particles that roll along the floor. These particles may lodge in floor cracks and start a smoldering fire which often does not become active until many hours after the worker has left the premises.

It is recommended that inflammable debris be removed from within 20 feet of the place where the welding is being performed, and that wooden flooring or combustible ceilings be wet down before starting oxy-acetylene welding. If convenient, asbestos cloth or sheet-metal coverings are advised. Asbestos or metal shields may also be used as guards to prevent hot sparks from flying. Brick crevices should be filled with sand. It is preferable to move the work, if possible, rather than carry on the operation in a hazardous location.

Progress in Tool Engineering

THE Machine and Tool Progress Exhibition was held in Convention Hall, Detroit, Mich., March 9 to 12 inclusive, in conjunction with the annual meeting of the American Society of Tool Engineers. About 160 manufacturers exhibited the latest developments in all classes of small and auxiliary tool equipment for machine tool using plants. These exhibits included various types of standard and special cutting tools and materials, measuring and gaging appliances, work-holding apparatus, and other products of interest to the tool engineer.

During the meeting, two technical sessions were held, of which J. R. Weaver, director of equipment of the Westinghouse Electric & Mfg. Co., was chairman. The subject of one session was "Preparing Standards for Surface Quality," by Dr. E. J. Abbott, president of the Physicist Research Co., Ann Arbor, Mich. This paper was discussed from the engineering viewpoint by Harry T. Woolson, executive engineer of the Chrysler Corporation, and from the shop viewpoint by R. V. Hutchinson, designing engineer of the Olds Motor Works, and F. J. Malone, assistant to the president of the Hercules Motors Co.

The second technical session dealt with the selecting and buying of equipment. A paper on this subject was presented by Edwin Johnson, manager of costs studies, Packard Motor Car Co. This subject was discussed from the shop viewpoint by P. W. Brown, general factory superintendent of the Wright Aeronautical Corporation; from the purchasing viewpoint by Tom Higgins, purchasing agent of the General Electric Co.; and from the supplier's viewpoint by A. H. d'Arcambal, consulting metallurgist of the Pratt & Whitney Co.

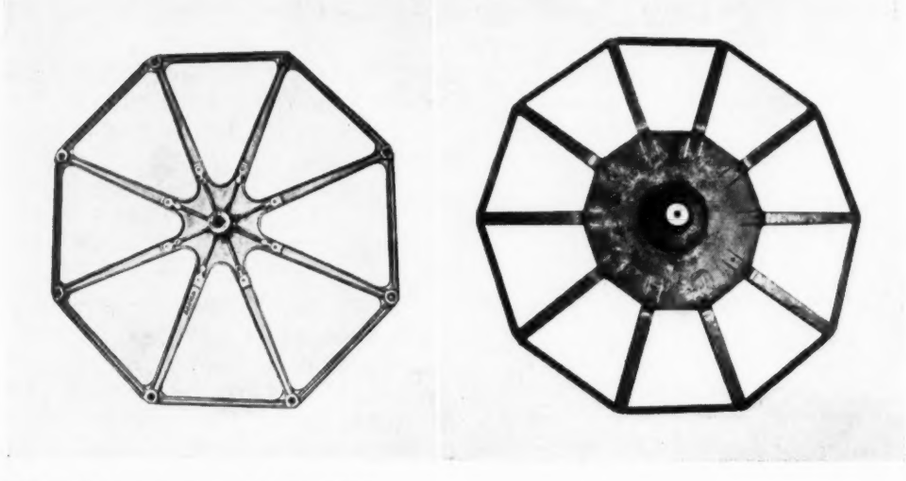
The following new officers were elected: President, Walter F. Wagner, master mechanic of the Lincoln Motor Co.; first vice-president, James R. Weaver; second vice-president, George Smart, tool supervisor, Allis-Chalmers; and secretary, Charles F. Staples, chief engineer, Giern & Anholtt Tool Co.

At the annual dinner, Ralph E. Flanders, president of the Jones & Lamson Machine Co., spoke on the subject "The Tool Engineer."

Welding Spiders for Oven Tray Conveyor

THE problem encountered by the Middleby & Marshall Oven Co., Chicago, Ill., in the production of oven tray conveyor spiders such as shown in the accompanying illustration was to obtain a structure so accurate that the measurements from the bushings at the ends of the spokes to the hub center, and the distance between the bushings of adjacent spokes, would be exact to within 0.001 inch. Difficulty in obtaining this accuracy by the method of construction formerly employed led to the use of electric welding. This method provided the necessary accuracy and also reduced the cost.

The spider made of cast steel at a cost of $130 is shown to the left in the illustration, while the spider fabricated of arc-welded steel at a cost of only $70 is shown to the right. The arc-welded steel spider is fabricated by Lincoln arc welding equipment from 3/16 inch plate and T-iron, the latter material being used for the rim. The spokes are of steel plate bent in a brake to form a tapered channel section. A flat tapered plate welded to this channel section completes the box type construction. The center disk consists of two plates welded to the spokes, and a 2-inch strap is welded around the periphery between the spokes to provide a box-like construction.



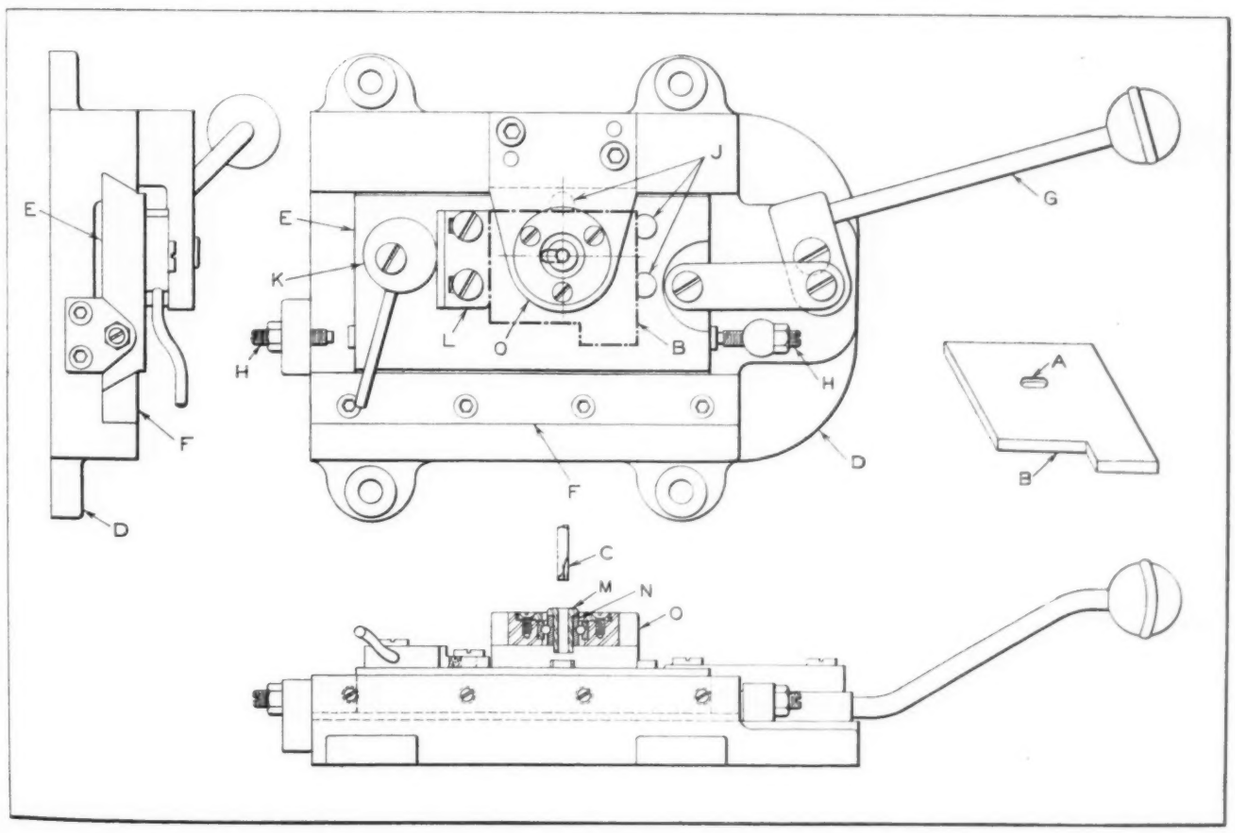
(Left) Cast-steel Spider for Oven Tray Conveyor. (Right) Arc-welded Spider that Proved More Satisfactory than the Cast-steel Design

Fixture for End-Milling Blind Slot

By ROBERT W. HUXTABLE, Orange, Mass.

The fixture shown in the accompanying illustration is used in a small high-speed drill press for milling the blind slot *A* in the cold-rolled steel plate *B*. The slot is 3/16 inch wide, 7/16 inch long and 1/16 inch deep. The cutter used is a two-lipped end-mill *C*, formed approximately as shown in the illustration. The work *B* is simply clamped in the slide *E*, which is moved back and forth quite rapidly by means of handle *G* while the end-mill *C* is fed slowly down to the required depth. The end-mill is then raised and the work removed and replaced by a new piece.

Any wear between the cast-iron base *D* and the machine-steel slide *E* may be taken up by the adjustable gib *F*. The length of the reciprocating movement imparted to the slide by the link mech-



Fixture for End-milling Slot A 1/16 Inch Deep in Plate B

anism operated by the handle *G* is governed by the two adjustable stops *H*. The work is located on the slide by the pins *J*, and is clamped in place by rotating the cam *K* which actuates pad *L*. The end-mill *C* is held in the regular drill chuck, and is guided by the bushing *M* which rotates in the small sealed type ball bearing *N*. The bearing is mounted in the housing *O*, fastened to the base of the fixture.

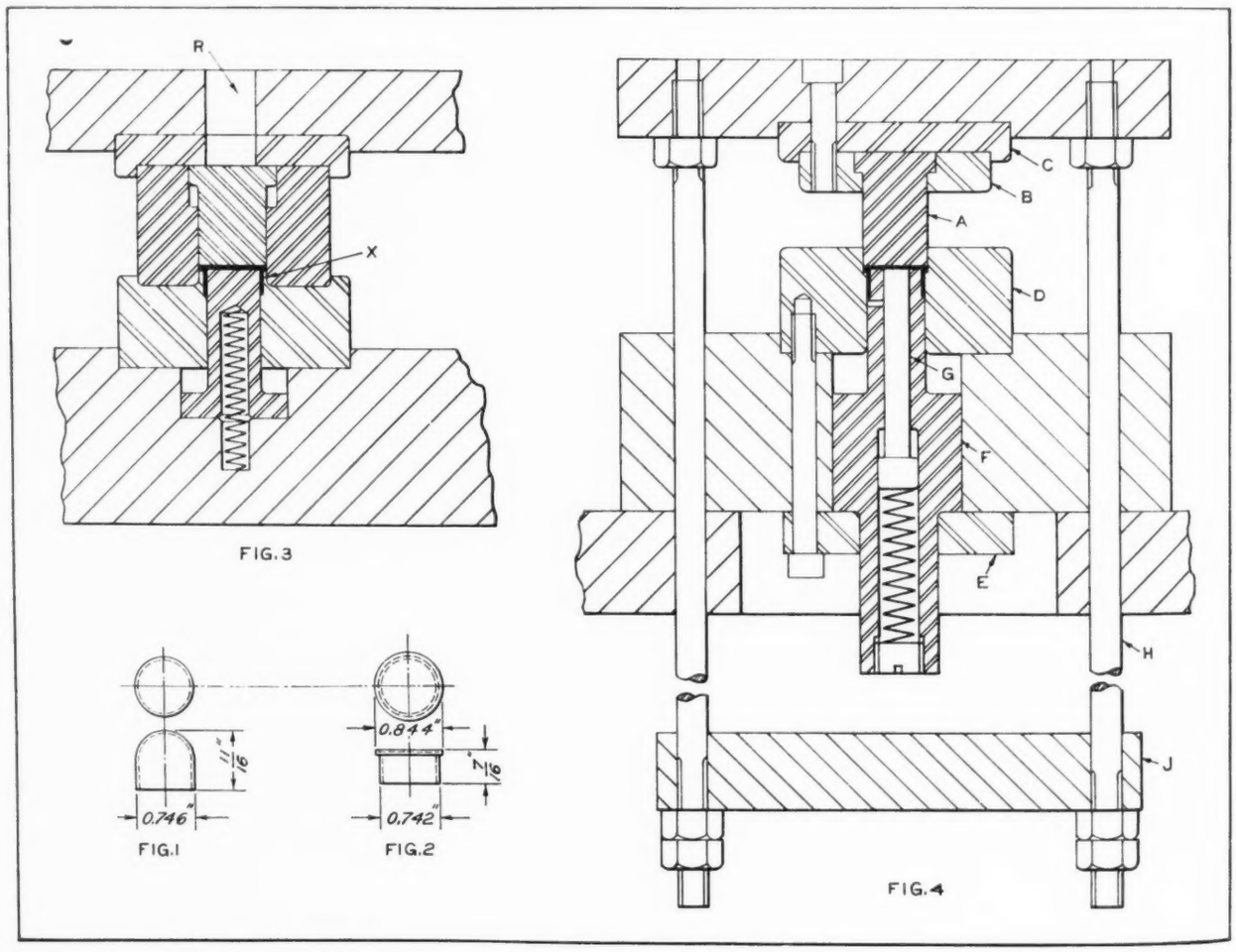
Correcting a Heading Die that Did Not Work

By JOHN J. McHENRY, Detroit, Mich.

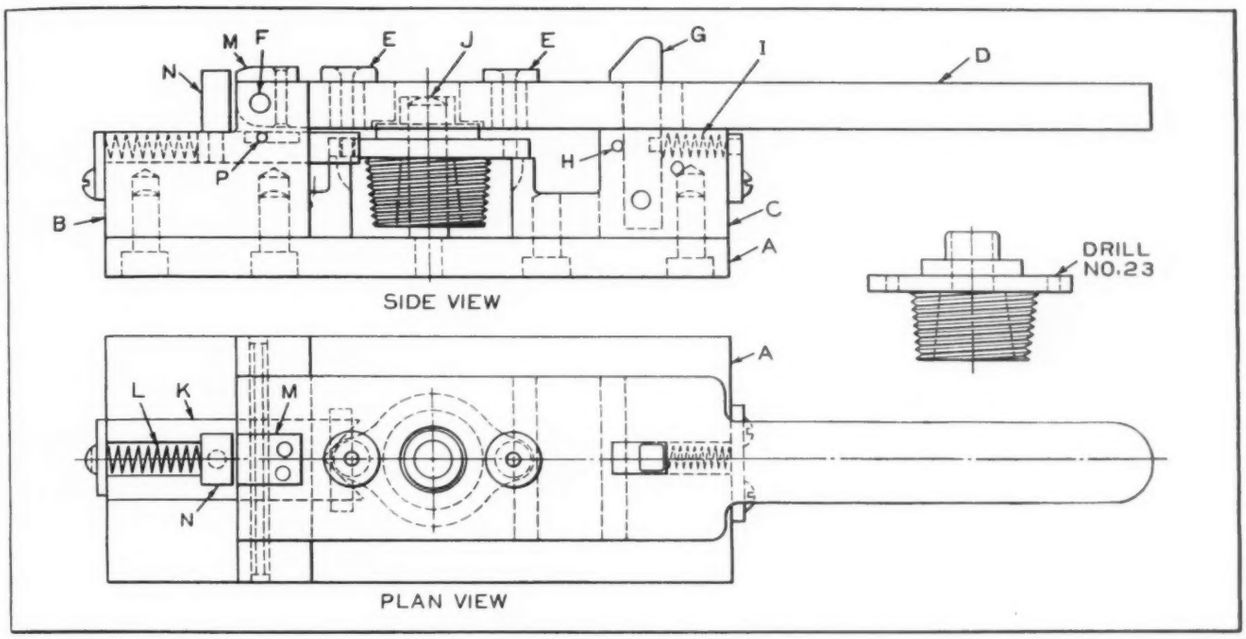
The shell illustrated in Fig. 1 was to be headed as shown in Fig. 2. The die originally constructed for the heading operation is illustrated in Fig. 3. This die was designed to upset the head of the shell so that it would fit the upper die tight enough to insure carrying the shell upward until ejected near the top of the stroke by a knock-out bar operating through the hole at *R*. However, this die was unsatisfactory. Slight variations in the length of the cup, as well as variations in the stock thickness and temper, resulted in varying degrees of friction between the shell head and the die wall. The same characteristics also caused variable results on the open end of the shell. Under these conditions the die functioned properly only about 75 per cent of the time, the cup remaining in the lower die 25 per cent of the time. Die breakage through the thin wall at *X* also required correction.

After the die was rebuilt as shown in Fig. 4, it operated satisfactorily in all respects. The rebuilt die consists primarily of the following parts: A heading punch *A*, retained by four screws which pass through plates *B* and *C;* a heading die *D*, retained by four screws which pass through plate *E;* a dual ejector, made up of a main body *F* and an auxiliary part *G;* two knock-out rods *H;* and knock-out bar *J*. The dual ejector also serves as a means for locating the shell for the heading operation.

With the press ram of the die shown in Fig. 4 at the top of its stroke, the knock-out rods *H* are adjusted so that the knock-out bar raises the ejectors *F* and *G* until member *F* comes in contact with the face of the die *D*. The auxiliary part *G*, being spring-actuated, will then project above the face of the ejector. With the die in this position, the



Figs. 1 and 2. Cup before and after Heading. Fig. 3. Unsatisfactory Design of Heading Die. Fig. 4. Rebuilt Heading Die



Jig for Drilling Two Holes in Flange of Small Part

operator places a shell over the auxiliary part *G* with the open end located over the end of member *F*, and trips the press.

On the up stroke of the ram of the press, the knock-out bar *J* throws the main ejector violently upward against the lower face of the die *D*. This removes the headed shell from its confined area, so that the auxiliary ejector can complete the ejection of the shell by a snappy spring action. The completed part simply springs upward and falls into a box at the back of the inclined press.

Jig for Drilling a Small Flange

By GEORGE WILSON, Marshalltown, Iowa

A jig for drilling two holes in the flange of a small awkward-shaped part is shown in the accompanying illustration. This jig permits the drilling to be done very rapidly on a single-spindle machine. A feature of the jig is the method by which the lugs on the work are centered automatically under the drill bushings, irrespective of variations in the radius of the lugs and their distance from the center.

The members *B* and *C* are mounted on base *A*. The drill bushings *E* are held in plate *D*, which is hinged on pin *F*. Latch *G* serves to hold plate *D* down against stop *C*. Pin *H* prevents *G* from being pushed out of place by spring *I* when *D* is raised.

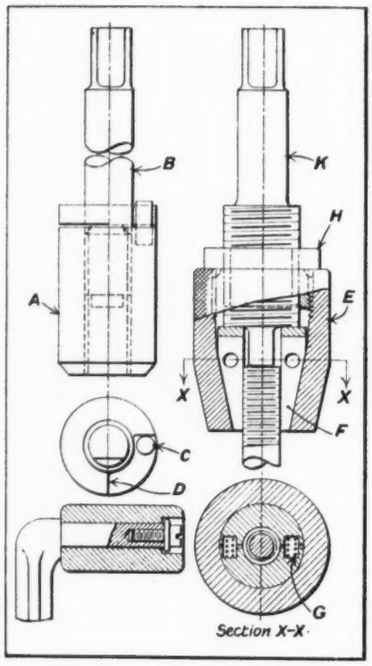
The work is located or centered by means of the stud *J*. The lugs on the work are supported on stops integral with members *B* and *C*. Slide *K* is used to center the lugs on the work under the bushings *E*. The end of slide *K* is made V-shaped to engage the lug on the work. Slide *K* is a sliding fit in the base, being pressed against the work by spring *L*. Pin *P* in a slot in part *K* serves to hold *K* down in place and limit its movements. The end of rod *D* acts as a cam at *M*, pushing against post *N* which is attached to slide *K*.

Stud Drivers of Simple Design

Two stud drivers that have proved satisfactory are shown diagrammatically in the accompanying illustration (see next page). The driver shown in the upper views to the left is of very simple design. The body *A* is tapped to suit the thread on the stud to be driven. The lower face of the flange clears the end of the body by about 1/64 inch and part of the flange is cut away to provide two stop faces for the pin *C*, which is driven into the body of the driver after assembly to limit the rotary movement of the shank.

In use, the body is threaded on the stud with the shank in the position indicated in the plan view. As the end of the shank within the body engages the end of the stud, the latter is forced to turn with the driver. To disengage the driver, the shank is turned in an anti-clockwise direction. For the first quarter turn, until the stop face *D* strikes the pin, the shank moves independently of the body, thus relieving the axial pressure. The driver is then removed as a unit.

The cross-section views to the right show another driver which, though of rather more elaborate design, has a number of advantages. It is quicker in operation, is adapted for machine stud driving, and will accommodate various sizes of studs. The body *E* is bored out to take the threaded collet *F*, which has a tapered outer surface and is split into two parts. The collet sections are held



Two Simple Types of Stud Drivers

apart by springs *G*. To facilitate assembly, a threaded plug *H*, the flange of which is flatted to receive a spanner wrench, is fitted in the body. The shank *K* is provided with a comparatively coarse thread and is screwed into plug *H*. A pilot on the end of the shank projects into the collet and the flat end face bears against a thrust washer which, in turn, engages the face of the collet.

As the shank is withdrawn part way from the body, the collet follows it, owing to the action of the springs, and the jaws open. When a stud is to be gripped, it is placed between the collet jaws, in contact with the shank. The latter is then screwed into the body until the jaws grip the stud, one and one-half to two turns sufficing for this operation. The knurling on the body of the driver facilitates turning the shank. With the stud securely held in the driver, it can be quickly driven into place. At the end of the operation, the driver is released by reversing the procedure, only one and one-half to two turns being required for releasing it.

Both drivers are rotated by means of a modified standard lathe carrier. The square-headed clamping screw of the carrier has a hole drilled through it radially to receive a short rod or bar which enables the flattened shanks of the drivers to be gripped firmly without using a spanner wrench. The driving shank of the carrier serves as a handle, being constructed as shown in the cross-section view in the lower left-hand corner. The shank has a Bakelite sleeve, which is made a running fit on the turned-down portion of the carrier. B. M.

Tailstock Attachments

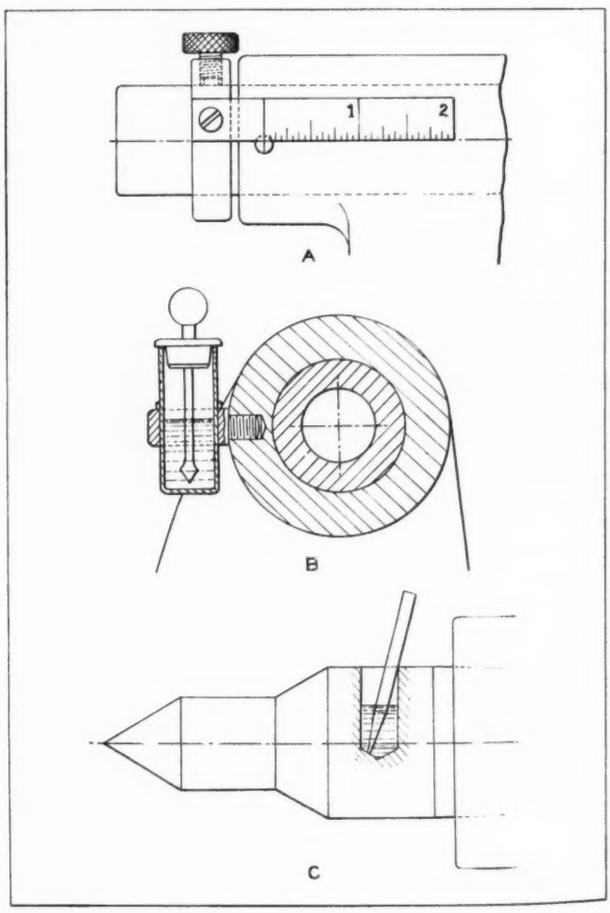
If the spindle of a small lathe is being used for drill feeding, a depth gage attachment, such as shown at *A* in the accompanying illustration, will be found a great convenience. It consists of a brass collar which is a sliding fit on the spindle, a knurled-head brass screw for clamping the collar to the spindle, and a short rule secured in a slot in the side of the collar as shown. A short plug is fitted into the tailstock housing, which has a shoulder filed on the upper side along which the rule slides. A zero line is scribed on the end of this plug to which the first division on the rule is set before starting to feed the drill.

Views *B* and *C* are suggestions for center oilers. The one at *B* is used when the tailstock has no cast-on oiler. A hole is drilled and tapped at the back of the tailstock for the ring screw which holds the oil container. The oil container is made with a shoulder or band soldered to it and can be lifted out of the ring when necessary.

The oiler shown at *C* is intended for fine turning, the hole being made in the center close to the point where the oil is to be applied. This arrangement is particularly useful when pieces are mounted on the centers for a short period only. A plain piece of small rod can be utilized as an oil feeder; or if the operation is of a dusty nature, a stopper-top oiler, such as shown in view *B*, can be employed. F. H.

* * *

A miniature railroad system, complete to the last detail, will be one of the features of the Santa Fé Railroad's exhibit at the 1939 Golden Gate Exposition in San Francisco.



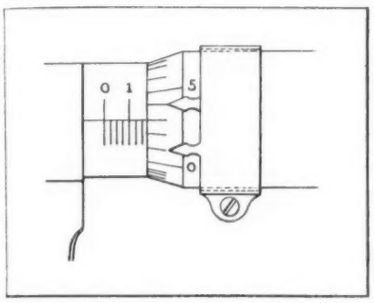
Attachments for Lathe Tailstocks

Ideas for the Shop and Drafting-Room

Time- and Labor-Saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work

Adjustable Limit Indicator for Micrometer

A limit indicator for a micrometer having pointers that can be set to include as many graduations on the micrometer barrel as desired is shown in the accompanying illustration. The plain split inner band of brass has a pointer formed on it. The outer split band has a pointer and clamping lugs. The two bands are adjusted as required and clamped in place by a screw that passes through the lugs. F. H.



Tolerance or Limit Indicator for Micrometer

Fastening Drawings to Press-Wood Surface with Scotch Tape

In many cases, drawings can be fastened to drawing-boards more satisfactorily with Scotch tape than with the conventional thumb-tacks or paper fasteners. To prevent the tape from sticking to the usual manila paper covering on the drawing-board, it is necessary to shellac the paper. Although the paper covering may be shellacked on both sides, it is usually affected by changes in the weather, which make frequent readjustments necessary.

This and other difficulties have been overcome by covering the wooden drafting-board with press wood, which is made by the Masonite Products Co., Chicago, Ill. Before the press wood is applied, it is given a smooth glossy lacquer finish. The glossy surface is desirable because it has greater resistance to dirt, is easier to wash, and permits the Scotch tape to be removed readily. Soap and water can be used for general cleaning, but gasoline is necessary for the removal of the sticky substance that occasionally remains on the board after removing the Scotch tape.

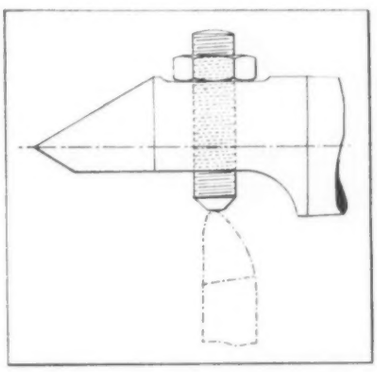
The longer the Scotch tape remains on the board, the more difficult it is to remove the sticky substance. The color of the lacquered surface can be chosen to suit individual taste, cream, white, and ivory being frequently used. The compass center point can be shifted many times without making an unsightly hole in the drawing paper when it is mounted on the lacquered surface of the wood.

Since the press-wood surface is harder than the ordinary wood drawing-board, the pencil point wears away much faster, even though a 9H grade is used. The lines also do not have such a clear-cut appearance. This can be remedied by using two sheets of vellum together, or by placing the usual manila paper under the vellum. Since the press-wood surface is not affected by climatic changes, the drawing paper or vellum will remain taut much longer. In general, the writer has found the press wood to be superior to the usual wood surface.

Rochester, N. Y. THEO. H. BAUCK

Lathe Center with Tool-Setting Screw

A stud or ring for setting a lathe tool for turning work to a given diameter or a stepped stud for setting to several diameters can be placed on the tailstock spindle or on the center. The accompanying diagram shows a type of tool-setting screw which provides for a good range of small sizes. It is convenient for roughing work, as it eliminates the necessity of measuring the work. Two screws of this kind can be used for setting to two different diameters. F. H.



Lathe Center Equipped with Screw for Setting Tool

* * *

Correction

On page 299 of January MACHINERY, the design of a valve gear for a surface grinding machine was shown. Due to erroneous information furnished to us, this valve gear was credited to the British firm of John Lund, Ltd., when, as a matter of fact, this design is one developed and used by the Heald Machine Co., Worcester, Mass.

Questions and Answers

A Department in which the Readers of MACHINERY are Given an Opportunity to Exchange Information on Questions Pertaining to the Machine Industries

Validity of Typewritten Signatures

L. T. P.—Recently one of our representatives made a sales contract. The purchaser signed it in ink, but our representative failed to sign the contract, although his and our firm name were typewritten at the end of the contract. The purchaser now refuses to accept and pay for the equipment covered by the contract on the grounds that the contract is void, because our representative failed to sign it in ink. Can we hold the purchaser?

Answered by Leo T. Parker, Attorney-at-Law
Cincinnati, Ohio

If the person who ordered the equipment was authorized to make this contract for his firm, the outcome of the litigation depends solely on whether the seller's representative intended to bind his firm when he affixed the typewritten signature to the contract. If so, the contract is valid. Any form of an authorized employe's signature, such as that made with a typewriter, initials, rubber stamp, and the like, is enforceable.

However, where a person sues on a contract signed with a signature other than a written one, he must prove that the signature was affixed *with the intention of making a valid contract*. This law is well settled, because the courts have held that any form of signature is valid, the legal difference being that the validity of a written signature may be proved by the signature itself, but it must be proved by testimony that any other kind of signature was affixed by a person having proper authority and with the intention of completing a valid contract.

Welding Stainless Steel to Low Nickel Steel

D. A.—Can stainless steel be welded to low nickel steel? What type of welding rod should one use?

Answered by Editor of "Nickel Steel Topics"

Stainless steel can be welded to low nickel steel. It is suggested that for this purpose any commercial, coated 18-8 stainless steel welding rod available on the market be used.

Medium steel electrodes can be used, but there is danger of brittleness in the weld. With stainless steel electrodes, however, adequate strength and ductility result if the weld is otherwise properly made. Coated rods are commonly used, in order to shield the arc and avoid oxidation of the chromium. Reversed polarity is usually employed. The voltage, amperage, and size of rod depend to a large extent on the type of work being done. The recommendations of the rod manufacturer are usually safe to follow in this respect. The preheating of the work before welding sometimes produces a better weld, particularly if the sections are heavy.

Another welding rod suitable for this kind of work is a 25 per cent chromium, 12 per cent nickel-steel electrode.

* * *

Nuts for Welding to Sheet Metal

Five years ago, the Ohio Nut & Bolt Co., Berea, Ohio, developed two styles of bolts that could be welded directly to appliances and equipment made from metals. One of these bolts had welding points under the head, and the other, welding points on top of the head. The company has now patented a welding nut and the process of its manufacture. This nut has four welding points or projections, so that it can be readily welded to equipment made from metal.

In designing metal appliances, these nuts open up many new possibilities. For example, welding nuts can be applied to the internal parts of gas meters for the purpose of assembling brackets of other parts without danger of leakage through the metal shell of the meter. Similar advantages can be obtained in the manufacture of electric transformers and in the making of electric refrigerators and storage tanks. In many cases, these nuts can be welded to sheet metal, thereby eliminating the use of more expensive forgings or castings. They can not only be used for attaching threaded parts, but blank nuts can be made to provide bearings for shafts or push-rods. These nuts are available, at present, in sizes up to and including 3/8 inch.

* * *

A financially sound railroad transportation system is one of the fundamental requirements for a healthy industrial recovery. That the railroads must have additional revenue should be obvious without argument. In this connection, it is of interest to note that payroll taxes for retirement and unemployment compensation under the Social Security Act cost the railroads in 1937, $92,500,000. This tax will be nearly $20,000,000 greater in 1938, because of the increased rate of the unemployment compensation tax that took effect on January 1.

Adapting Alternating-Current Motors to Machine Tool Needs

Modifications in the Mechanical and Electrical Characteristics of Polyphase Alternating-Current Motors to Meet Special Requirements are Described in This Article

By T. R. LAWSON, Motor Division
Westinghouse Electric & Mfg. Co.
East Pittsburgh, Pa.

ALTHOUGH the standard foot-mounted, general-purpose, squirrel-cage motor is used for the main drive of many machine tools, the builders are now making the electrical equipment so much an integral part of their products that the number of these motors made with electrical or mechanical modifications to suit various machine tool requirements is constantly increasing. The machine tool designer or engineer usually wants to know at the outset how much more than standard a certain modification will cost or how much greater torques, etc., can be obtained. Thus throughout this article the general-purpose motor is used as the basis of comparison in presenting the data and information intended to answer these questions.

A "standard" or general-purpose squirrel-cage motor is accepted by the electrical industry as an open type, foot-mounted, self-ventilated, sleeve-bearing motor, operating with a 40-degree C. temperature rise under continuous full-load conditions (15 per cent service factor), with normal torque and normal-current inrush on starting. The normal starting torque is 1.5 times the full-load torque on four-pole motors and decreases for lower speed motors to 1.15 times full-load torque on twelve-pole motors. The normal pull-out torque is twice the full-load torque, as shown by curve I, Fig. 1. The normal locked-rotor current at full-voltage starting is about six and a half or seven times the full-load current.

Electrical Modifications to Suit Requirements

One of the most common electrical modifications of the general-purpose motor is the low-current inrush, normal-torque design. This motor differs from the general-purpose type only in that its locked-rotor current is six times the full-load current or less. Torques are normal, as shown by curve II. The use of the low-inrush normal-torque motor is governed by the power company's or the individual plant's requirements, and not by the machine tool application.

The machine tool industry offers a greater demand than other fields for intermittent rated one-hour, 50-degree C. rise or one-half-hour, 50-degree C. rise, open, polyphase, normal-torque motors. One-hour motors are usually applied where cutting tools idle about 50 per cent of the time. Half-hour ratings are applied where the tool is loaded only about 30 per cent of the time. The maximum fully loaded running time on such motors is one-hour and one-half-hour, as the names imply. Usually the next smaller horsepower general-purpose, continuous rated frame size is used, and these inter-

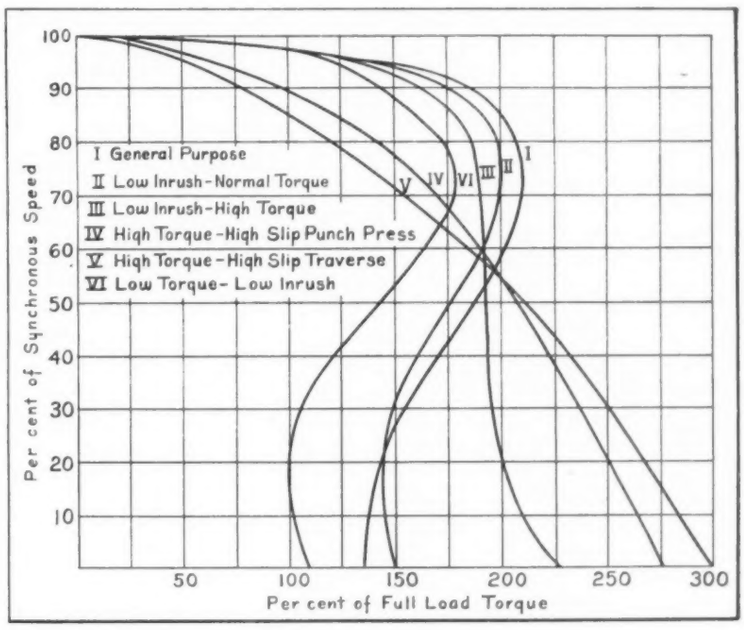


Fig. 1. Torque Characteristics of Different Types of Motors

mittent ratings are priced slightly lower than the same horsepower continuous type, as shown in the accompanying table, in which the costs of various modifications are compared on the basis of percentage of regular motor price.

Until recently there have not been so many requests for high starting-torque, normal-slip, low-current inrush polyphase motors on machine tool applications. This type was designed to give starting torques of two to two and one-half times full-load torque, and six times full-load current or less on full-voltage locked rotor; see curve III. They are generally applied to "break away" heavier starting loads than normal without excessive starting currents.

Drill manufacturers recently have been using this class of motor on their drilling and tapping machines which are required to make as many as fifteen reversals per minute. It has been found that with a low inertia connected load, these high-torque, low-inrush motors will handle a reversing job of this kind better than a general-purpose motor, even though not as well as the high-slip, high-torque type mentioned later. However, the high-torque, normal-slip motor is between the general-purpose and the high-slip motor in price, and is therefore used in smaller sizes on tapping duties requiring more than four to six reversals and less than twenty reversals per minute.

Up to and including 7 1/2-horsepower, four- and six-pole, 60-cycle speeds, some electrical manufacturers guarantee these stock high-torque, normal-slip motors for fifteen reversals per minute. Above fifteen or twenty reversals per minute, designs and prices are special and no general rule applies. Both the Cincinnati Bickford Tool Co. and the Carlton Machine Tool Co., for example, use the high-torque, normal-slip, low-inrush motor to advantage on their drilling and tapping machines.

High-Slip High-Torque Motor Applications

For flywheel, or heavy inertia machines such as punch presses, shears, bolt headers, etc., high-slip, high-torque motors are used. The term "high-slip motor" is generally accepted to mean a motor with

Cost of Modifications in Regular Design of Polyphase Alternating-Current Motors

Type of Motor to which Modifications Apply			
General-purpose, sleeve-bearing, polyphase, squirrel-cage motor of normal torque and current inrush type required to operate continuously with temperature rise of 40 degrees			
Type of Modification or Special Equipment Applied to Motor	Approx. Per Cent of Regular Motor Price to be Added or Deducted	Type of Modification or Special Equipment Applied to Motor	Approx. Per Cent of Regular Motor Price to be Added or Deducted
(Modifications in Electrical Characteristics)		(Modifications in Mechanical Characteristics)	
Constructed to operate for one-hour periods with temperature rise of 50 deg. C. at normal torques	— 13	Ball bearings	+ 5
Constructed to operate for one-half hour periods with temperature rise of 50 deg. C. at normal torques	— 15	Motor without feet (NEMA frame 225 to NEMA 505 frame)	+ 7 to + 5
Low-current inrush, normal-torque continuous (7 1/2 to 30 horsepower NEMA frames W-405 and smaller)	0	Single bearing with shaft, without feet (Limit NEMA 326 frame)	— 4 1/4
Low-current inrush, high-torque continuous (Limit NEMA 326)	+ 5	Single bearing with shaft, without feet (Above NEMA 326 frame)	— 3 1/4
Low-current inrush, high-torque continuous (NEMA 364 to 405 frame)	+ 7 1/2	Stator and rotor only, with frame (Limit NEMA 326 frame)	— 10
High-torque, high-slip continuous operation	+ 40	Stator and rotor only, with frame (Above NEMA 326 frame)	— 7 1/2
High-torque, high-slip, constructed to operate for one-hour periods with temperature rise of 50 degrees C. (Limit, 15 horsepower)	+ 10	Stator and rotor only, without frame (Limit NEMA 326 frame)	— 15
High-torque, high-slip, constructed to operate for one-hour periods with temperature rise of 50 degrees C. (Above 15 horsepower)	+ 15	Stator and rotor only, without frame (Above NEMA 326 frame)	— 12 1/2
High-torque, high-slip, constructed to operate for one-half- or one-quarter-hour periods, with temperature rise of 50 degrees C.	— 6	Bracket boss mounting, without feet (NEMA 225 frame to 505 NEMA frame)	+ 12 to + 8
High-torque, frequent-reversal (15 reversals per minute) up to 7 1/2 horsepower, 4 and 6 pole.	+ 7 1/2	Bracket flange mounting, without feet (225 NEMA frame to 505 NEMA frame)	+ 25 to + 16
(Modifications in Types of Enclosures)		Ring-base mounting, without feet (225 NEMA frame to 505 NEMA frame)	+ 25 to + 16
Totally enclosed, fan-cooled, continuous	+ 65*	Horizontal side mounting, sleeve bearing	0
Totally enclosed, non-vent, continuous		Vertical side mounting ball-bearing (Addition made for ball bearings only)	+ 5
Drip-proof or semi-enclosed, continuous	+ 7 1/2	Dynamic balance, as low as 0.00025 inch Vibrometer (225 NEMA frame to 505 NEMA frame)	+ 12 to + 3
Splash-proof, weatherproof, continuous	+ 7 1/2	Close clearance sleeve bearings, 0.002 inch	+ 5
Totally enclosed, pipe forced vent, continuous	+ 20	Limited end play, sleeve bearings	+ 10

*Depends on size, time, and temperature.

a slip of between 7 and 15 per cent. The punch press type of high-slip motor has a slip of 7 to 12 per cent and a starting torque of 250 to 300 per cent of the full-load torque, as shown by curve IV, Fig. 1. Such high starting torques bring a flywheel up to speed rapidly, and the high slip allows the flywheel to give up its kinetic energy on peak loads, thereby relieving the motor itself of such peaks.

High-slip, high-torque motors are considerably higher in price for a given horsepower rating than the general-purpose motor. However, when it is considered that a higher horsepower general-purpose motor would be required to do the same job, the high-slip motor, from the correct application standpoint, is no higher in price.

The thirty-, fifteen-, or five-minute rated high-torque, high-slip, squirrel-cage motors have from 10 to 15 per cent slip and 250 to 300 per cent starting torque; are used on rapid-traverse, heavy lathe tailstocks or similar auxiliary motions requiring high torque for short periods (see curve V).

Reversing Motors for Tapping Operations

Drilling and tapping machines which reverse frequently have called forth from the electrical industry in the last few years their own motors for direct spindle drive. The demand is for small single-speed or multi-speed ratings designed for as many as fifty and sixty reversals per minute intermittently. The main use embodies a prewound stator core and rotor, less the shaft, for built-in construction. For example, the Charles G. Allen Co., Barre, Mass., uses high-torque, multi-speed motor parts on drilling and tapping spindles for frequent reversing duty which are designed especially for this application by Westinghouse in collaboration with the company's engineers. Motors of two ratings are used—a three-horsepower, two-, four-, six-, twelve-pole, and a two-horsepower, four-, six-, eight-, twelve-pole type. The motors, four of which are shown in Fig. 2, are designed to give the especially high pull-out torques desirable in drilling, and to withstand as high as fifty reversals per minute on tapping duty.

Up to this point only normal-torque or higher than normal-torque motors have been mentioned. Generally the less said of motors having only full-load torque, or lower, on full-voltage starting, the better. However, there are many applications in the machine tool field where the latter type of low-torque motor is the correct one to use.

Low-Torque Motors with Smooth-Starting Characteristics

The woodworking industry's sanders, band saws, and also internal tube-polishing machines require low-torque, smooth-starting characteristics to prolong the life of belts and saw blades. The motors designed for this service have 100 per cent of full-load torque or less on full-voltage starting, and 175 per cent of full-load torque or greater on pull-out (see curve VI, Fig. 1). The starting current on full voltage is low, and the speed regulation is excellent, due to the low-resistance rotor used and the consequent low slip under load. The cost is about 5 per cent higher than the equivalent rating general-purpose motor. This type of motor is used by the Mattison Machine Works on its internal tube grinding and polishing machine.

The grinding medium of this equipment is a flexible abrasive belt. In operation, the abrasive belt is passed through the tube and the ends are joined to make it endless. The belt passes around a pulley on the driving motor at one end of the machine, and around an idler having a tensioning device at the other end. The belt must be narrow in order to pass through the tube, and obviously, light torques are all that are required on starting, while higher than full-load torque would only subject the belt to severe jerks.

Modifications in Mechanical Features

The machine designer has considered the motor for some time as part of his machine, and has given considerable thought to methods of utilizing available motor drives. As a result, it has been demonstrated that the cost of the complete machine can be reduced, space conserved, and appearance greatly improved by the utilization of standard motor parts, which are adaptable to a wide variety of integral motor mountings.

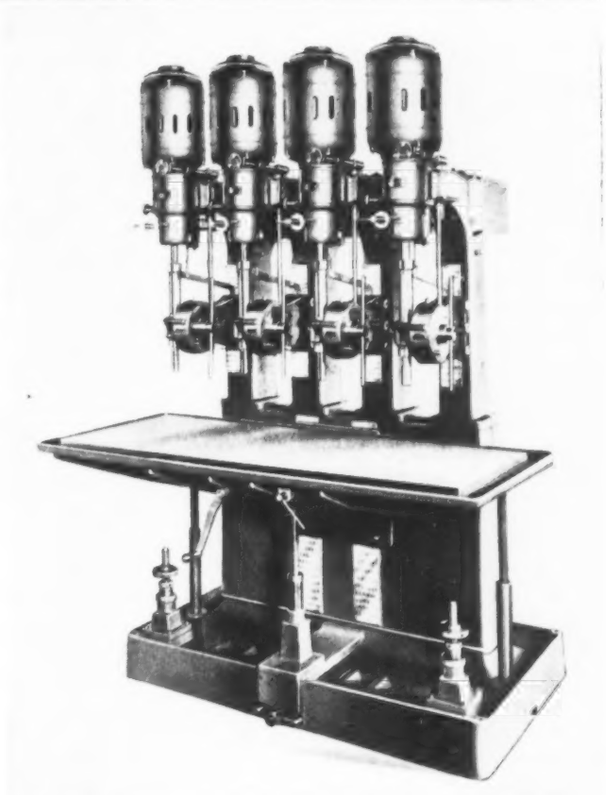


Fig. 2. Multi-spindle Drilling and Tapping Machine Equipped with Motors Having Four-speed Parts Adapted for Fifty Reversals a Minute

In addition to the use of its various types of mountings, the general-purpose polyphase motor, and any of its electrical modifications mentioned previously, is applied regularly on machine tools with the following types of enclosure: Totally enclosed fan-cooled; totally enclosed non-ventilated; drip-proof; semi-enclosed; splash-proof; and totally enclosed, pipe-forced ventilated.

The totally enclosed fan-cooled motor for continuous ratings in five-horsepower sizes and larger has the unquestioned advantages of smaller size and lower price over the totally enclosed, non-ventilated construction. However, in the smallest integral horsepower continuous ratings, and also on the larger short-time ratings, the physical dimensions of these two constructions are about the same, and the price advantage is with the totally enclosed, non-ventilated type, due to its simpler construction.

Applications of Pipe-Ventilated Motors

The totally enclosed pipe forced-ventilated motor is used in unusually severe atmospheres which are detrimental to motor insulation, and on severe-duty cycles to provide adequate cooling. The motor manufacturer specifies the volume and pressure of the forced air and the machinery manufacturer purchases a suitable blower after he has determined the length and lay-out of the air piping.

An approximation of the size of blower required can be made by using an air volume of 150 cubic feet of air per minute per kilowatt loss in the motor. The amount of air required should be delivered at the motor vent openings at 1 ounce pressure, and does not take into account the loss of pressure in the piping.

As an example of the pipe-ventilated motor in severe atmospheric conditions, the Ingersoll Milling Machine Co. recently applied a Westinghouse 150-horsepower, sixteen-pole, 60-cycle squirrel-cage, totally enclosed, pipe forced-ventilated motor on a new 70-ton machine used for scalping aluminum cakes to obtain a high-quality finish preliminary to rolling operations. The machine employs a 66-inch diameter face mill which is believed to be the largest milling cutter of this type in existence.

There were two reasons for choosing the pipe forced-ventilated construction. First, the 66-inch cutter revolving at approximately 150 revolutions per minute, and having cutting fluid poured on it through the center of the spindle, created a heavy mist in the room. Because of the extremely moist atmosphere and the probability of flying chips, total enclosure of the motor was demanded. Second, a totally enclosed fan-cooled motor of this rating is larger in size than the pipe forced-ventilated type and much more expensive, even considering the external blower and ventilating pipes required with the forced-ventilated motor.

The 30-horsepower, two-speed carriage motor of the Bonnot Co.'s billet chipper is a good example of a severe-duty cycle necessitating a forced-ventilated motor construction. This carriage motor, which is required to start and stop as many as fifty times per minute with a heavy friction load, jockeys a carriage carrying the cutter into various positions over the billet, so that cracks or flaws can be chipped from the billet surface preparatory to rolling.

Pipe adapters are furnished on front and rear brackets to receive the forced air from the auxiliary blower. Single-end ventilation is used, air entering one bracket and discharging through the other. Because the rotor in such a motor is the member sustaining the greatest losses, the ventilating air is directed through openings in the rotor punchings, and no air discharge is provided in the motor frame. The openings in the rotor punchings serve the double purpose of reducing the rotor inertia and providing cooling ducts.

Dynamically Balanced Motors

Other common motor mechanical modifications employed by the machine tool industry are listed in the accompanying table with their respective price comparisons in terms of percentage of regular motor costs. Since dynamic balancing of polyphase motors is specified to a great extent by the machine tool builders, motor manufacturers' standard practice in this respect may be worthy of mention.

Polyphase, alternating-current motors operating at more than 1800 revolutions per minute are dynamically balanced by most electrical manufacturers as part of their standard shop procedure, and no addition in price is made by these manufacturers unless special limits of balance are specified. Motors operating at 1800 revolutions per minute or slower speed motors are dynamically balanced for an approximate price addition ranging from $7 on the smaller ratings to $16 on the larger ones.

If no limit of balance is specified when dynamic balance is requested, the Westinghouse Electric & Mfg. Co. meets a maximum vibration of the motor frame of 0.001 inch or better, with the motor running idle on a flat plate, not bolted down. However, if the machinery manufacturer desires, he may specify a balance as close as 0.00025 inch vibrometer reading at the normal addition in price. On NEMA frames 204 and larger, a balance of 0.0001 inch vibrometer reading may be specified at double the normal dynamic balance charge noted above.

* * *

Standards for Brinell Tests

A British Standard Specification No. 240 has been published relating to Brinell hardness testing. This specification outlines the manner in which tests should be carried out, standardizes the thickness of the test specimen, and gives other information pertaining to Brinell tests for the guidance of those engaged in this work. Copies of the specification can be obtained from the Publications Department, British Standards Institution, 28 Victoria St., London, S.W. 1, England. The price of the publication is 2/2.

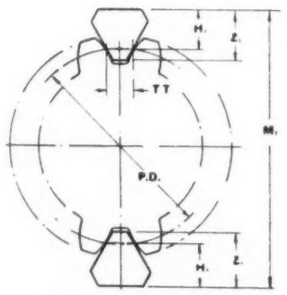
Gear Measuring Blocks

A SYSTEM of checking the pitch diameter and tooth thickness of spur and helical gears with measuring blocks used in conjunction with micrometers has been developed by the Illinois Tool Works, 2501 N. Keeler Ave., Chicago, Ill. Each set consists of three blocks, two male and one female, as shown in the illustration, and is constructed for a specific pitch and pressure angle. Two male blocks are used on gears with an even number of teeth, and the combination of one male and one female for gears with an odd number of teeth, as shown in the views at the head of the accompanying table.

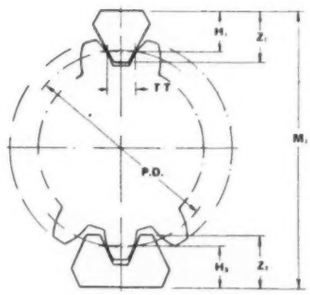
The blocks are in effect theoretical rack teeth, and it follows from the principle of the rack tooth that all points of contact between the block and the gear tooth contour are located on the line of action. In the case of a spur gear, this line of contact follows a straight line which runs parallel with the axis across the face of the gear. The contact in a helical gear runs diagonally across the face, but is also a straight line.

Regardless of the tooth thickness or size and pitch of the gear, measuring blocks check while in contact with one certain part of the involute—that of the line of action. Therefore, they always check the true pitch line condition of thickness and space; variations in the form of the involute do not affect the reading. The character of the contact made by the blocks is such that there is less likelihood that

Data for Checking Spur and Helical Gear Sizes with Measuring Blocks



Even Number of Teeth



Odd Number of Teeth

Diametral Pitch	Circular Pitch	Measurements for Even Number of Teeth			Measurements for Odd Number of Teeth		
		H_1	TT	Z_1	H_2	TT	Z_2
3	1.0472	0.5333	0.5236	0.8000	1.0000	0.5236	1.2666
4	0.7854	0.4000	0.3927	0.6000	0.7500	0.3927	0.9500
5	0.6283	0.3200	0.3142	0.4800	0.6000	0.3142	0.7600
6	0.5236	0.2666	0.2618	0.4000	0.5000	0.2618	0.6333
7	0.4488	0.2286	0.2244	0.3429	0.4286	0.2244	0.5428
8	0.3927	0.2000	0.1963	0.3000	0.3750	0.1963	0.4750
9	0.3491	0.1778	0.1745	0.2667	0.3333	0.1745	0.4222
10	0.3142	0.1600	0.1571	0.2400	0.3000	0.1571	0.3800
11	0.2856	0.1455	0.1428	0.2182	0.2727	0.1428	0.3454
12	0.2618	0.1333	0.1309	0.2000	0.2500	0.1309	0.3167

Method of Checking Pitch Diameter—In measuring a gear in which the tooth space equals one-half the circular pitch—that is, when no allowance is made for backlash, M_1 = pitch diameter + (2 × H_1) for gears with an even number of teeth; M_2 = pitch diameter + H_1 + H_2 for gears with an odd number of teeth.

In most cases, the tooth space is made wider than one-half the circular pitch. This is done to provide the gears with the backlash required for smooth operation. The wider tooth space will, of course, bring the measuring block nearer the center of the gear, the exact amount of this change being equal to the normal backlash on one side of the gear tooth multiplied by the cosecant of the pressure angle. Thus, for gears with an even number of teeth, M_1 = pitch diameter + (2 × H_1) — (normal backlash × cosecant of pressure angle); for gears with an odd number of teeth, M_2 = pitch diameter + H_1 + H_2 — (normal backlash × cosecant of pressure angle).

For use in the foregoing formulas, we have: Cosecant 14 1/2 degrees = 3.9939, and cosecant 20 degrees = 2.9238. It should be borne in mind that the figures for backlash to be used in these formulas are those for one gear only.

The circular backlash = normal backlash × secant of the pressure angle.

Example—A 6 diametral pitch, 20-degree pressure-angle gear having 24 teeth, a pitch diameter of 4.000 inches, and a normal backlash of 0.0025 inch is to be measured with 6 diametral pitch male blocks.

Referring to the accompanying table, H_1 = 0.2666; thus, according to the formula for an even number of teeth, we have: M_1 = 4.000 + (2 × 0.2666) — (0.0025 × 2.9238) = 4.5259 inches.

Method of Calculating Tooth Thickness—For calculating the tooth thickness from a reading over the measuring blocks, we have: Actual tooth thickness = 1/2 circular pitch — (normal backlash × secant of pressure angle).

In this equation, we substitute:

Normal backlash = (pitch diameter + 2 × H_1 — reading over blocks) × sine of pressure angle.

For use in these formulas, we have: Sine 14 1/2 degrees = 0.25038; sine 20 degrees = 0.34202; secant 14 1/2 degrees = 1.0329; secant 20 degrees = 1.0642.

incorrect readings will result from minor cutting depressions in the surface.

Gear measuring blocks have large flat top surfaces which provide a solid seat for the micrometer anvils and thus facilitate correct reading. They can be used for all stub-tooth systems of the same pitch, because there is sufficient clearance between the bottom surface of the block and the root diameter of the gear.

* * *

Broaching the Keyslots in Lock Cylinders

By JOHN MARKSTRUM, Chief Engineer
Continental Division, Ex-Cell-O Corporation
Detroit, Mich.

Keys for the so-called Yale locks, as practically everyone can verify by referring to his key-ring, are made not only with the transverse grooves that engage tumbler pins in lock cylinders, but also with one or more grooves cut lengthwise on each side. These lengthwise grooves give a zigzag or wrinkled section that engages slots of corresponding form in the lock cylinder. Typical lock slots are shown in Fig. 2 on a considerably enlarged scale. The thinness of the key section, which is frequently less than 1/32 inch, makes it necessary for the cylinder slots to be cut from the solid in one operation.

Keyslots of intricate contour can be readily broached in these brass lock cylinders. Fig. 1 shows six broach sections which are mounted end for end in a suitable holder for a typical job. The first section at the starting end of the broach is generally in the form of a straight slotting broach for cutting that part of the slot nearest the periphery of the lock cylinder. Such a broach section is seen at the left in the illustration. The succeeding broach sections must produce the formed portions of the slot. They must be carefully designed in order to insure sufficient strength in the teeth and to provide ample chip clearance.

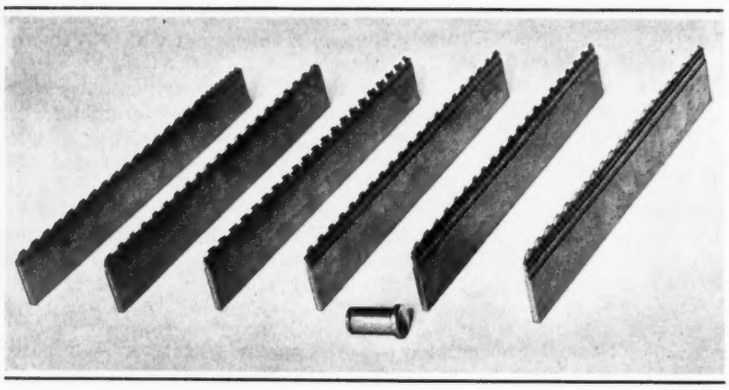


Fig. 1. Six Broach Sections Employed in Cutting a Keyslot in Lock Cylinders such as Seen in Front of the Broaches

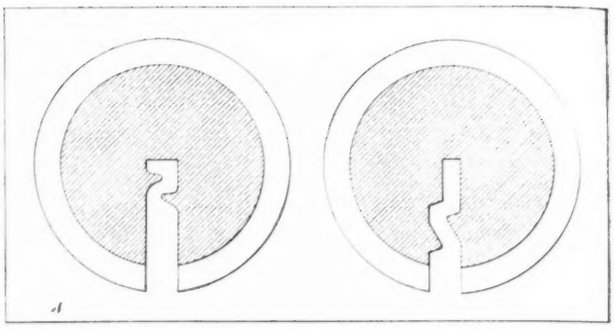


Fig. 2. Diagrams Showing the Form of Two Typical Keyslots in Lock Cylinders that are Produced in One Operation by Broaching

At points where the slot inclines at a steep angle, obviously a small difference in the height of the broach teeth means a large increase in the amount of stock removed by the teeth. For this reason, broaches of this type are generally designed with several teeth roughing out part of the slot at each point where the slot angle changes. These roughing teeth are followed by teeth that cut the slot form by the progressive or generating broaching method. Each different inclination of a keyslot necessitates a different cutting direction and another application of the progressive broaching principle.

These frail broaches are often applied at cutting speeds of 100 feet a minute, and it is therefore of utmost importance for the broach designer to determine closely the amount of stock that every tooth in the broach will remove, so as to avoid excessive cutting stresses on any tooth.

* * *

Lapping the Cutting Edges of Taps Increases Life

To increase the cutting life of a tap and to eliminate the small roughened surfaces on the cutting edges of the threads that look like hacksaw teeth under a magnifying glass, it is good practice to lap the tap after it has been sharpened. This produces a very keen cutting edge. The average tap can be lapped in about twenty seconds per land.

This lapping is done with a small pencil wheel, and has the further advantage that it changes the direction of the scratches. If the tap is examined with a powerful glass after the lapping, it will be observed that the little "hacksaw" teeth have been almost entirely removed. Experience indicates that this lapping process will sometimes increase the life of a tap between grinds several times. The cost of lapping is very small, the only thing required being an assortment of small mounted abrasive points and a true-running spindle.

Metal Spraying in General Shop Practice

By S. LIPONI
Machinists Tool Grinding Co., Chicago, Ill.

Few people realize to what extent metal spraying can be applied in ordinary shop practice. Thousands of dollars worth of scrapped and under-sized parts can be salvaged by metal spraying or "metallizing," as it is frequently called, with tin, zinc, lead, Monel metal, copper, "Nichrome," aluminum, brass, stainless steel, babbitt, etc.

The delays and worries due to breakdowns can be eliminated and maintenance costs reduced on shafts, bearings, and other machine parts by the building-up process of metallizing. Sprayed metal bearing surfaces have proved excellent. The sprayed surface is slightly porous. Many experiments have proved that if such a sprayed metal surface is submerged in oil for fifty hours, it will absorb approximately 10 per cent of its bulk of oil. In one case, the sprayed surface was 1/16 inch thick; the bearings treated continued to run for 22 1/2 hours after the oil supply had been cut off without giving difficulty, because the absorbed oil acted as a lubricant.

Among other applications may be mentioned a 3-inch piece of steel tubing, which when sprayed with 1/8-inch thick copper coating, can be used for purposes where copper rolls have been employed in the past. A container sprayed with a zinc coating becomes a zinc container at one-tenth of the usual cost.

* * *

Grinding Multiple Punch that Pierces Seventy-Two Holes Simultaneously

In making steel shelving at the plant of the Lyon Metal Products, Inc., Aurora, Ill., a long punch-holder is used for piercing the holes in the side frames. The holders for some of these punches are 10 feet long and have seventy-two punches which pierce seventy-two holes in one operation. The punches are ground to different heights so that they do not all enter the die at the same time. With this arrangement, a shearing effect is obtained.

Economical grinding of these punches presented a real problem. To purchase a surface grinder with a 10-foot table for this job would have required a considerable investment for a machine which would not have given proper control for the short stroke required. The problem was finally solved, however, by using a No. 72 Covel hand-feed surface grinder, equipped with adjustable supports on each side of the machine. The illustration shows how the supports were rigged up with rollers and arranged for height adjustment. Each punch is ground separately until it is properly sharpened. The table is then moved either up or down as required by the height of the next punch which is then moved into position for grinding.

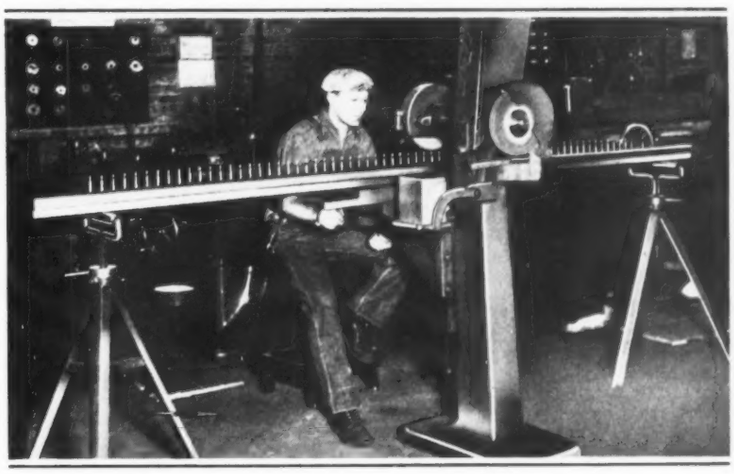
The actual grinding time depends on the condition of the punch, but the average time is approximately forty-five seconds. The time for moving from one punch to the next is about fifteen seconds, so that the complete grinding cycle is approximately one minute per punch. Thus the total grinding time in this case is seventy-two minutes.

* * *

Of the $12,500,000,000 collected in taxes by federal, state, and municipal governments in the United States last year, approximately 70 per cent, or $8,750,000,000, were "hidden" taxes. In other words, on an average, every man, woman, and child in the country paid over $67 in taxes without even being aware of the fact that they were being taxed. The politician knows that wasteful expenditures would have to stop if it were not for these indirect taxes. If these taxes were levied directly on the people of the country, the politicians would soon be forced to economize with public money.

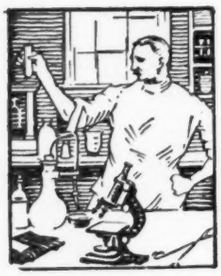
* * *

During recent years, industry has shown an increasing tendency toward the use of a combination of die-castings and molded plastics in the assembly of a great variety of products. The die-castings are used when strength and ease of manufacture are essential. The plastics, on the other hand, furnish color and appearance in a great many applications where the cost of finishing die-castings would not be justified. Therefore, a combination of the two processes and materials will produce products that would not be equally satisfactory if either of the two materials were used alone.



Grinding the Punches in a 72-hole Punch on a Covel Grinder Equipped with Adjustable Supports

MATERIALS OF INDUSTRY



THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

"Ludlite"—A New Stainless-Steel Product for Home and Industry

A composite product that consists of an outer surface of thin stainless steel permanently bonded to a backing of tough flexible non-metallic material has been placed on the market by the Ludlum Steel Co., Watervliet, N. Y. This product is known as "Ludlite." The backing material makes it possible to cement Ludlite to plaster, wood, fiber board, concrete, and other surfaces. The material is now being produced in rolls 2 feet wide and in lengths of 50 and 100 feet, as well as in tiles 4 inches square.

A feature of this material is the ease with which it can be used, as it can be cut on the job with an ordinary pair of heavy scissors and then shaped and cemented, nailed, or screwed in place. Ludlite can, therefore, be readily applied in constructing stainless-steel shelves, sinks, and drainboards in pantries and kitchens; and for other decorative purposes in the home. It is also suitable for lining radiator recesses in walls. In industry, Ludlite can be used for lining bins and boxes, for insulating refrigerators, for trimming and covering automobile running boards, and for a variety of other purposes. 201

Malleable-Iron Castings in Automotive Construction

Malleable-iron castings are used for a wide variety of parts in the construction of automobiles and motor trucks; in fact, the automotive industry consumes one-half the output of malleable iron produced. It is interesting to note that safe operation of motor vehicles depends upon the reliability of malleable-iron castings, this material being used for such parts as brake and clutch pedals, wheel hubs, differential carriers, gear-cases, and rear-axle housings.

Brake pedals are a good example of the dependability of malleable iron, as these parts must endure many suddenly applied loads. Tests have shown that brake pedals can be twisted to the

Ludlite Sheets can be Easily Stamped, Cut, or Formed

Typical Malleable-iron Castings Used in Building Automobiles and Motor Trucks

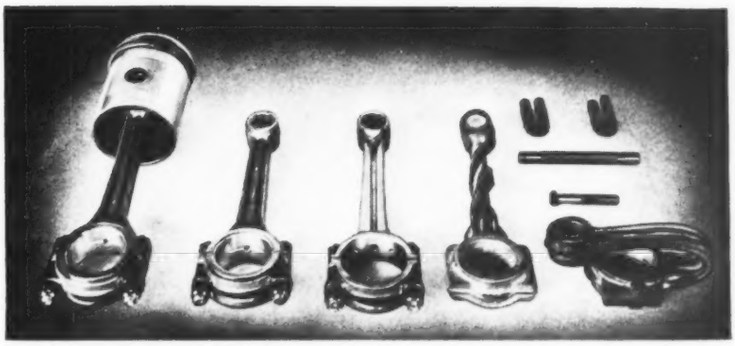
To obtain additional information about materials described on this page, see lower part of page 562.

shape of a corkscrew without fracturing. It is this ductility that minimizes the hazard of sudden failure.

Malleable iron has been found suitable for the front wheel hub of passenger automobiles, which must withstand the side thrust of a skidding or swaying car, as well as constant pounding resulting from road jolts. Dual flange hubs, such as are used on the rear wheels of trucks, must withstand even more severe service, because of the conflicting stresses imposed on these hubs in sudden stopping.

Among the reasons why malleable iron is suitable for such usage is a yield point sufficiently high to meet strength requirements, and, in addition, unusual resistance to impact. Spring hangers are made of malleable iron to provide protection against occasional overloads. While ordinary loads or regular stresses are chiefly taken by the main brace or bracket, so that cast-iron hangers are capable of meeting routine demands, the shock incident to occasional overloads justifies the application of a tougher and more ductile material.

Among motor truck parts, and particularly on the modern six-wheelers, malleable-iron castings are used for axle housings, spring chairs and perches, and radius-rods. The spring chair pivots on a cross-shaft and carries the entire weight of the body, frame, and load at the rear of the truck. The radius-rods carry all thrust and torque loads due to driving and braking, and are, therefore, subject to both shocks and twist.....202



Connecting-rods of Autocar Trucks are Made of Steel Containing 3 1/2 Per Cent Nickel; Rods that have Successfully Withstood Severe Bending Tests are Shown at the Right

Nickel Alloy Steels Used in Motor Truck Manufacture

Unit	Part	S.A.E. Steel
Engine	Connecting-rods	2340
	Connecting-rod bolts	3135
	Inlet valve	3140
	Cylinder-head studs, crankcase (main bearing) studs	2330
Transmission	Transmission gears	4620-1; 4820 and 3312
	Transmission mainshaft	4340
	Clutch collar	4620-1
	Clutch hub	4340
	Transmission shifter-rods	3120
Rear Axle	Rear-axle driving-axle shaft	4340
	Rear-axle ring gear	2520
	Rear-axle bevel gears and jackshaft	3312
	Rear-axle differential gears	2515
	Rear-axle differential bolts	2330
	Rear-axle hub studs	2330
	Rear-axle wheel studs	3135
Front Axle	Front-axle centers	3130
	Front-axle spindles	3130
	Front-axle steering arm	3130
	Steering-ball bolt	2515
Spring Equipment	Spring clips	3120
	Spring tube and bolt	3115
	Spring cross-shaft	3140
	Frame bracket bolts	2330

Steels Used in Motor Trucks to Withstand Severe Service

The heavy-duty service to which the driving parts of motor trucks are customarily subjected obviously demands that the steels from which such parts are made possess a high degree of strength, toughness, and dependability. It is therefore of considerable interest to note the steels which a prominent motor truck manufacturing concern uses for the various important parts of these vehicles. The accompanying table, recently presented in *Nickel Steel Topics*, published by the International Nickel Co., New York City, lists the nickel alloy steels used by the Autocar Co., Ardmore, Pa., for engine, transmission, axle units, and miscellaneous spring parts. 203

Oil-Cans with Transparent Plastic Containers

A transparent non-breakable plastic material that is not affected by oils, or gasoline and their derivatives, is used for the container of a line of oil-cans being placed on the market by the Universal Plastics Corporation, 235 Jersey Ave., New Brunswick, N. J. These "Scan Cans," as they are called, are constructed with a flexible copper-plated metal bottom in order to eliminate the chance of leakage. The spout is made of a heavy-gage copper-plated material and can be unscrewed from the body of the plastic container in the same manner as from ordinary metal cans.

Besides a weight one-third less than that of metal cans of the same size, this plastic oil-can enables the user to observe the amount and quality of oil in the can at any time without squirting oil on a rag or on the floor.....204

To obtain additional information about materials described on this page, see lower part of page 562.

NEW TRADE LITERATURE

Recent Publications on Machine Shop Equipment, Unit Parts and Materials. To Obtain Copies, Check on Form at Bottom of page 561 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in April Number of MACHINERY

Electrical Equipment

GENERAL ELECTRIC CO., Schenectady, N. Y. Circulars GEA-288A, 880A, 1587C, 1884A, 2011A, 2473, 2516, 2545, 2627, and 2635, illustrating and describing, respectively, auto-transformers for starting synchronous and squirrel-cage induction motors; crane protective panels; combination magnetic switches for induction motors; multi-speed induction motors; portable electric indicating instruments; push-button stations; photo-electric relays; alternating- and direct-current equipment for traveling electric cranes; motors for belt-driven blowers on air-conditioners; and recording instruments for reducing production and maintenance costs, as well as equipment investment. 1

Copper Steel

UNITED STATES STEEL CORPORATION SUBSIDIARIES, 434 Fifth Ave., Pittsburgh, Pa. Booklet entitled "A Little Copper in Steel Gives a Lot of Protection," containing the results of tests made by the American Society for Testing Materials on the atmospheric corrosion resistance of various grades of steel and iron, with special reference to copper steel. 2

Broaching and Straightening Presses

OILGEAR CO., 1302 W. Bruce St., Milwaukee, Wis. Bulletins 32100, 32200, and 33101, describing the new Oilgear line of gooseneck presses, straightening presses, and side-plate presses, respectively, suitable for forcing, broaching, assembling, straightening, and general manufacturing purposes. 3

Gear-Testing Equipment

NATIONAL BROACH & MACHINE CO., Shoemaker and St. Jean Sts., Detroit, Mich. Circular entitled "Gear Accuracy Checked Quickly and Cheaply," illustrating and describing the "Red Ring" Model SIC universal gear tester made by this company, which has been designed to combine accuracy of measurement with speed of application. 4

Arc-Welding Equipment

HARNISCHFEGER CORPORATION, 4536 W. National Ave., Milwaukee, Wis. Booklet entitled "New Advances in Arc-Welding Equipment Design," containing technical information on recent developments in the arc-welding industry which should be of interest both to the welding operator and to the welding student and engineer. 5

Tool Steels

FIRTH-STERLING STEEL CO., McKeesport, Pa. 118-page loose-leaf catalogue on tool steels, containing six divisions covering high-speed and hot-work steels; tool and die steels; stainless steels; cold-drawn steels; and sintered tungsten carbides. The book gives analyses, physical properties, and heat-treatments. 6

Metal-Coating Processes

CALIBRON PRODUCTS, INC., 51 Lakeside Ave., West Orange, N. J. "Calibron Notebook," containing a review of the present methods of coating metals with metals, including a new method known as the Martin Process; a discussion of the diffusion of metals; and historical notes on iron-aluminum-chlorine reactions. 7

Gages

LINCOLN PARK TOOL & GAGE CO., Lincoln Park, Mich. Booklet entitled "The L. P. Handbook of Gages," covering the various types of gages and precision tools made by the company, including applications of Carboloy cemented carbide in this field. One section of the book consists of gage standards prepared by the American Gage Design Committee. 8

Bakelite Laminated

BAKELITE CORPORATION, 247 Park Ave., New York City. Booklet describing the various Bakelite laminated products available and their diversified applications. Information is given on the physical, electrical, and mechanical properties of laminated sheets, tubes, and rods. 9

Heat-Treating Equipment

LEEDS & NORTHRUP CO., 4921 Stenton Ave., Philadelphia, Pa. Folder F-T625(6), entitled "Thirteen Thousand Pounds up to Normalizing Heat in Thirty Minutes in Modern Homo Furnaces," showing these furnaces used for tempering parts in a drive-chain plant. 10

Stressproof Steels

LA SALLE STEEL CO., P. O. Box 6800-A, Chicago, Ill. Booklet 30, describing the new La Salle stressproof process for producing cold-finished steel bars of both high strength and free machineability. Data on the physical properties of stressproof steels are included. 11

Milling Machines

GEORGE GORTON MACHINE CO., 1109 Thirteenth St., Racine, Wis. Catalogue 1400-A, illustrating and describing Gorton "Super-Speed" vertical high-precision milling machines, which are made in three sizes for tool, die, mold, and production work. 12

Needle Bearings

TORRINGTON CO., Torrington, Conn. Booklet containing reprints of a series of advertisements, which recently won honorable mention in the Annual Advertising Awards, dealing with the Torrington needle bearing, a new type of anti-friction bearing. 13

Grinding Fixtures

PUTNAM TOOL CO., 2981 Charlevoix Ave., Detroit, Mich. Folder describing the new Putnam universal

grinding fixture, designed for sharpening end-mills, but adaptable also for regrinding a wide variety of cutting tools. 14

Hydraulic Grinding Machines

LANDIS TOOL CO., Waynesboro, Pa. Catalogue L38, illustrating and describing the Landis 3-inch, Type C hydraulic chucking grinder, designed for the economical grinding of small parts that cannot be held between centers. 15

Roller Bearings

HYATT BEARINGS DIVISION OF GENERAL MOTORS CORPORATION, Harrison, N. J. Circular entitled "Your Ten Demandments are the Hyatt Ten Commandments," outlining ten advantages of Hyatt roller bearing design. 16

Welding Equipment

GENERAL ELECTRIC CO., Schenectady, N. Y. Bulletins GEA-2704, 2776, and 2791, illustrating and describing, respectively, arc-welding accessories; gasoline-engine driven arc welder; and thyratron control for spot-welders. 17

Surface Grinders

GALLMEYER & LIVINGSTON CO., 305 Straight Ave., S.W., Grand Rapids, Mich. Catalogue illustrating and describing the Grand Rapids line of high-speed hydraulic feed surface grinders. 18

Screws

AMERICAN SCREW CO., Providence, R. I. Bulletin descriptive of the American "Plus" screws, with the patented Phillips recessed head designed to give improved holding power and reduce assembly time. 19

Flexible Couplings

LINK-BELT CO., 519 N. Holmes Ave., Indianapolis, Ind. 1937 edition of illustrated book No. 1545, giving dimensions, ratings, and other data on the new Link-Belt RCB flexible coupling with divided rollers. 20

Electric Motors

FAIRBANKS, MORSE & CO., 600 S. Michigan Ave., Chicago, Ill. Bulletin 2260, describing the construction details of Fairbanks-Morse direct-current motors in sizes up to 200 horsepower. 21

Portable Electric Tools

BLACK & DECKER MFG. CO., Towson, Md. Annual catalogue, illustrating and describing the complete line of Black & Decker portable electric tools, including several new designs of drills, grinders, etc. 22

Assembling Facilities

HUNTER PRESSED STEEL CO., Lansdale, Pa. Folder on the company's facilities for assisting electrical and other manufacturers on assembly work, as well as on its designing, machining, and testing facilities. 23

Clutches

ROCKFORD DRILLING MACHINE DIVISION OF BORG-WARNER CORPORATION, 310 Catherine St., Rockford, Ill. Bulletin outlining the features and advantages of Rockford Over-Center clutches. 24

Oil-Cushion Bronze Bearings

BOSTON GEAR WORKS, INC., Hancock and Hayward Sts., North Quincy, Mass. Bulletin listing dimensions and prices of Oilite oil-cushion precision bronze bearings made by the Chrysler Corporation. 25

Portable Electric Tools

VAN DORN ELECTRIC TOOL CO., Towson, Md. 1938 catalogue, covering the complete line of Van Dorn portable electric tools, including some new designs of drills, screwdrivers, grinders, etc. 26

Thread Plug Gages

DETROIT TAP & TOOL CO., 8432 Butler St., Detroit, Mich. Circular entitled "Up to 40,000 More Holes," describing the wear resisting qualities and long life of Detroit Crobalt thread plug gages. 27

Safety Goggles

AMERICAN OPTICAL CO., Southbridge, Mass. Circular containing a chart that specifies the types of safety goggles to wear for protection against eye hazards in all the principal industries. 28

To Obtain Copies of New Trade Literature

listed on pages 560-562 (without charge or obligation) mark with X in squares below, the publications wanted, using the identifying numbers at the end of each descriptive paragraph; detach and mail to:

MACHINERY, 148 Lafayette St., New York, N. Y.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40

Name..... *Position or Title*.....

[This service is for those in charge of shop or engineering work.]

Firm.....

Business Address.....

City..... *State*.....

[SEE OTHER SIDE]

Gear-Finishing Machines

MICHIGAN TOOL CO., 7171 E. McNichols Road, Detroit, Mich. Catalogue illustrating and describing the new 860 gear-finisher and the new duplex gear-finisher made by this concern. 29

Machinists' Tools

UNION TOOL CO., Orange, Mass. Catalogue 38, containing data on this company's line of machinists' tools, including calipers, clamps, dividers, gages, punches, flexible rules, scribers, squares, etc. 30

Friction Clutches

CARLYLE JOHNSON MACHINE CO., Manchester, Conn. Catalogue on Johnson friction clutches, describing both the standard type and the Super Johnson clutch with Raybestos-faced expansion ring. 31

Testing Machines

TINIUS OLSEN TESTING MACHINE CO., 500 N. Twelfth St., Philadelphia, Pa. Circular descriptive of Olsen proving rings, with electrically vibrated reed, for calibrating testing machines. 32

Tungsten-Carbide Metal

SUPER TOOL CO., 356 E. Congress St., Detroit, Mich. Chart showing the grade of Teco tungsten-carbide metal suitable for machining various materials under different conditions. 33

Anti-Friction Bearing Mountings

R-S PRODUCTS CORPORATION, 4540 Germantown Ave., Philadelphia, Pa. Booklet on a line of housing covers, closures, flingers, etc., for anti-friction bearing mountings. 34

Lighting Equipment

GENERAL ELECTRIC VAPOR LAMP CO., 893 Adams St., Hoboken, N. J. Catalogue showing various industrial applications of Cooper Hewitt incandescent combination lamps. 35

Welding Equipment

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. Bulletin B2123, entitled "New Profits from Resistance Welding with Ignitron Split-Second Control." 36

Welding Machines

PIER EQUIPMENT MFG. CO., Benton Harbor, Mich. Circular illustrating and describing the Ace line of automatic motor-driven spot-welders for high-production work. 37

Squaring Shears

NIAGARA MACHINE & TOOL WORKS, 637 Northland Ave., Buffalo, N. Y. Bulletin SL, descriptive of the Series SL power squaring shears. 38

Pneumatic Wrenches

INGERSOLL-RAND CO., 11 Broadway, New York City. Circular 2360, describing a new larger size impact wrench, with greatly increased power. 39

Couplings

LOVEJOY TOOL WORKS, Chicago, Ill. Circular illustrating the LR Uniflex and Double-flex couplings. 40

* * *

National Small Business Men's Association

The National Small Business Men's Association, with headquarters in Akron, Ohio, a New York office at 41 E. 42nd St., and representation in twenty-six states, has been organized for the purpose of mobilizing the influence of small business men the country over so that their rights may be defended and the best interests of the whole country served.

Begun in November, 1937, three months before the Washington small business men's conference, this movement is headed by DeWitt M. Emery of Akron, who states that the Association is concentrating on a simple, common-sense program which urges tax relief, especially repeal of the Undistributed Profits Tax, the taking of Government out of business, and convincing assurance that business will not be harassed by the Government.

This idea should have a wide appeal to business men and, properly supported, should enable small business men at last to have a voice in government.

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 563-582C is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment mark with X in the squares below, the identifying number found at the end of each description on pages 563-582C—or write directly to the manufacturer, mentioning machine as described in April MACHINERY.

51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81
82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	

Fill in your name and address on other side of this blank.

To Obtain Additional Information on Materials of Industry

To obtain additional information about any of the materials described on pages 558-559 mark with X in the squares below, the identifying number found at end of each description on pages 558-559—or write directly to the manufacturer, mentioning name of material as described in April MACHINERY.

201	202	203	204

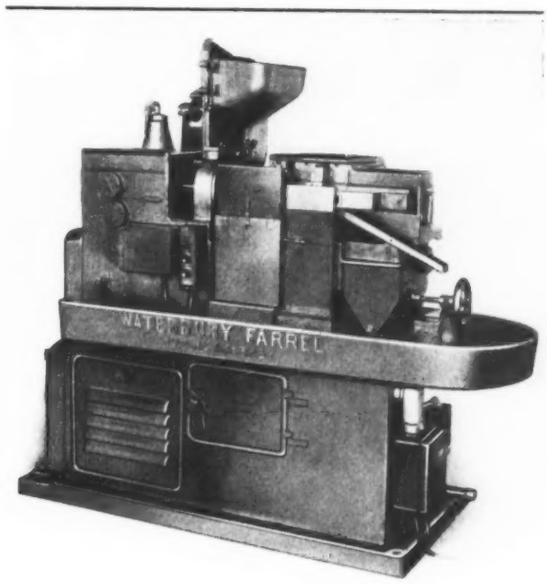
Fill in your name and address on other side of this blank.

Detach and mail to MACHINERY, 148 Lafayette St., New York, N. Y.

[SEE OTHER SIDE]

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market



Waterbury-Farrel Automatic Nut-tapping Machine Using Straight-shank Tap

Waterbury-Farrel Automatic Nut-Tapping Machine

The use of a stationary straight-shank tap is a distinguishing feature of an automatic nut-tapping machine being introduced to the trade by the Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn. Another feature of equal importance is the mechanical device employed to grip and revolve the nut blank while advancing it over the stationary tap at the precise linear speed required by the lead of the tap threads. The thread axis of the tap is kept in accurate alignment at right angles to the face of the nut under all conditions, so that any tendency to ream or otherwise distort the hole is eliminated. The relationship of the nut and tap during the operation can be compared to that existing between the threading tool and the accurately ground lead-screw of a precision lathe.

The advantages claimed for the machine are a degree of accuracy that makes it practical to produce Class 3 and Class 4 fits on a quantity basis; high-speed production; simplified method of chucking the tap; and easy operation, it being only necessary after setting up for any particular job to clamp the tap in place and start tapping; there is no preliminary "stacking" or loading of the tap.

One machine will tap nuts of several sizes. The intermediate or 1/2-inch machine illustrated will tap nuts up to 7/8 inch across the flats and 1/2 inch thick or the equivalent. Although the 1/2-inch machine can be utilized for sizes down to and including 1/4 inch, it is not as efficient on smaller sizes and is not recommended for them, except in special cases where it is desirable to take advantage of the full capacity of the machine. In general practice, the 3/8-inch machine is recommended for the smaller size nuts and the 3/4-inch machine for the larger sizes. However, the 1/2-inch machine will handle the majority of sizes in general use.

In operation, the nut blanks fall from the hopper down a chute which delivers them into line with and facing the tap directly in back of a revolving head. They are then pushed automatically through this head and into a driving jaw within the head. Each nut is held square with the tap and is screwed on it as the head revolves.

A three-fingered jaw is required for hexagonal nuts, and a four-fingered jaw for square nuts. The tap shank is of sufficient length to accommodate two pairs of mechanically operated clamps, by means of which the tap is held stationary. These clamps are engaged and released alternately to permit the tapped nuts which accumulate on the tap shank to be carried toward the end of the shank, from which they drop off and slide into a receptacle.

Both nut and tap are kept free from chips and are plainly visible while the machine is in operation. The chips are washed away by a lubricant and collect in a removable drain box within the pedestal, thus being separated from the nuts. The cutting oil is contained in a large tank in the pedestal. After draining back into the supply tank, the cutting oil is recirculated in a cool, clean condition.

To obtain additional information on equipment described on this page, see lower part of page 562.

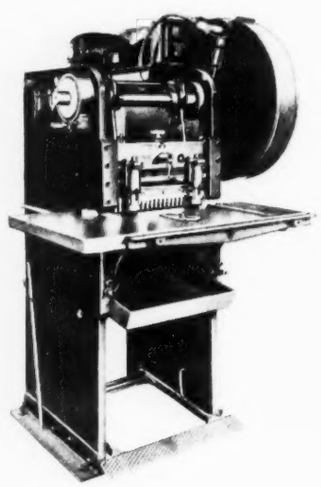
The machine is automatically lubricated, and is driven by a two-horsepower motor having a switch box and push-button control. Automatic safety devices are provided for the purpose of minimizing tap breakage and preventing machine damage in case imperfect blanks or other obstructions interfere with the normal operation of the tapper. Motor, oil-pump, drive parts, chip box, etc., are all housed in the pedestal, and are readily accessible. 51

Northill Counter-Thrust Square Shear

High-speed operation for both limited and long production runs and the ability to cut and notch intricate shapes from sheet metal are outstanding features of a new motor-driven counter-thrust square shear introduced by the Northill Co., Inc., 5221 San Fernando Road, W., Los Angeles, Calif. The machine is designed to handle stainless steel up to 1/16 inch in thickness, mild steel up to 3/32 inch, and duralumin up to 1/8 inch. The cutting width is 16 inches, and the maximum cut-off capacity 16 inches.

The blade operates 120 times per minute. The multiple-point clutch can be set to make one cut with each pressure on the treadle or to cut continuously as long as the treadle is depressed.

Each blade has four cutting edges, and the upper blade is mitered for notching. The work-table will accommodate adjustable holding gages which can be set to permit taking several cuts and notches when a sequence of operations is required. Direct reading of the cut-off length adjustment is obtained from a graduated steel tape. 52



Shear for Cutting Intricate Shapes from Sheet Metal

Landis Hydraulic External Chucking Grinder

To meet the need for a machine capable of economically grinding small parts that cannot be held between centers, the Landis Tool Co., Waynesboro, Pa., has developed the 3-inch Type C hydraulic chucking machine shown in Fig. 1. This machine has been designed to perform external grinding operations on a great variety of small parts. A battery of these machines installed in a sewing machine plant, for example, is being used to grind shuttle bodies, rotating-hook bobbin-cases, rotating hooks, and rotating-hook bobbin-case holders. In another plant, this machine is used for grinding the outer raceways of small inner roller-bearing rings. This taper grinding operation requires a slight swiveling of the work-head, which can be rotated through an angle of 90 degrees.

The operation of the machine is determined to a certain extent by the nature of the part being ground. In grinding the roller-bearing ring, the operator simply slips the work on the expanding collet and pushes the control lever at the front of the machine bed. This clamps the work to the spindle, which rotates continuously. The wheel then feeds in rapidly until it is about to come in contact with the work, at which point it slows down to the predetermined grinding feed, after which it advances at the slower rate of feed.

The wheel-base makes contact with a positive stop, and a short sparking-out period brings the work to size. At this point, the wheel-base quickly moves back to its original position. At the same time, the work is unclamped and is ejected from the expanding collet by means of solenoid-operated fingers. A new piece is then placed on the collet and the control lever pushed to the left, which causes the operation to be repeated on the new piece.

In grinding sewing machine parts, the control lever at the front of the bed is pushed to the left after the work has been placed in the chuck, but the chucking is not automatic. It is necessary that the operator chuck the work by manipulating the lever at the left-hand end of the work-head before the main control lever is touched. A second control knob at the right-hand end of the bed serves as a safety feature, as the operator must depress it with his right hand while pushing the lever at the front of the bed with his left hand.

If the control levers are not operated in this manner, the grinding cycle will not start. This arrangement prevents the operator from inadvertently starting the work rotation by pushing the main control lever

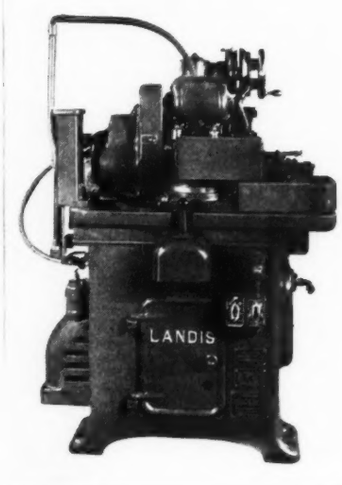


Fig. 1. Landis Hydraulic Chucking Machine

To obtain additional information on equipment described on this page, see lower part of page 562.

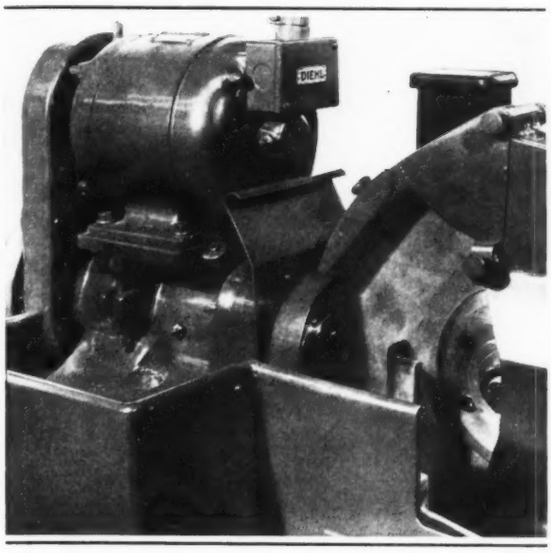
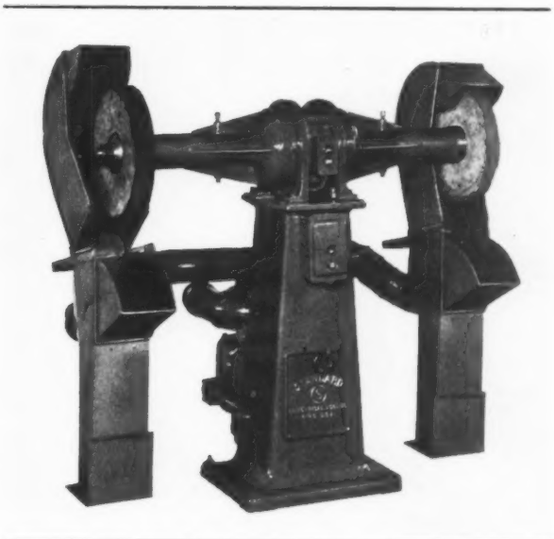


Fig. 2. Set-up for Grinding Face of Shuttle Body on Machine Shown in Fig. 1



Buffing and Polishing Machine Made by the Standard Electrical Tool Co.

while his hand is still on the chuck. As a further safety feature, the machine is arranged in such a manner that even after the operating cycle has been started, pushing the main control lever to the right will immediately reverse all movements, bringing the mechanisms to their inoperative state.

The wheel-truing device is hydraulically operated, and being mounted at the rear of the wheel, can be brought into use without disturbing the work set-up. To prevent the operator's hand from coming in contact with the wheel during the loading or unloading operation, a guard is provided, which automatically swings over in front of the wheel when the wheel-base recedes to its rear position. This guard automatically swings out of the way when the wheel-base moves forward.

All electrical control equipment is built into the machine and protected from coolant, grit, and dust. An electrical timing device accurately regulates the length of the grinding cycle. All motors are of the constant-speed type. The wheel-drive motor is 1 1/2 horsepower; the work-drive motor, 1/3 horsepower; and the pump-drive motor, one horsepower. The net weight of the machine, including electrical equipment, is 3200 pounds. 53

Exhaust System for Pedestal Type Buffing and Polishing Machines

The pedestal type buffing and polishing machines built by the Standard Electrical Tool Co., 1948 W. 8th St., Cincinnati, Ohio, in sizes from 1 to 20 horsepower are designed to permit attaching exhaust equipment to the pedestals. This equipment permits the collection of dust and refuse from grinding, buffing, and polishing when the machine is so located that it cannot be connected to the regular exhaust system.

The accompanying illustration shows the two-horsepower machine, which is available with a spindle speed of 1750 or 3450 revolutions per minute. The buffing motor is controlled by a magnetic starter located inside the base and connected with a push-button station at the front of the motor. The exhaust blower is driven by a ball-bearing motor having a speed of 3600 revolutions per minute. The motor and blower are mounted on a common base and attached to the back of the pedestal.

The blower motor is controlled by a separate push-button, manual starter at the front of the pedestal, which provides overload protection. If desired, the extra starter may be eliminated by having the blower motor and buffer motor connected, so that the two units operate simultaneously through the magnetic starter located inside the machine base.

An air-filtering stand is available for connection to the exhaust blower at the back of the machine, so that the air leaves the stand in a clean condition. 54

"Crobalt" Thread Plug Gages

A line of thread plug gages made of Crobalt has been added to the products of the Detroit Tap & Tool Co., 8432 Butler St., Detroit, Mich. The low thermal coefficient of Crobalt reduces to a minimum the changes in gage size resulting from changes in temperature. These thread plug gages are being manufactured in regular production to suit American gage design standards, and are furnished with aluminum hexagonal handles when desired. The thread gages carried in stock range from No. 8 machine screw size up to and including threads 1 1/2 inches in diameter in all standard sizes. 55

To obtain additional information on equipment described on this page, see lower part of page 562.

Bradford Automatic for Drilling and Tapping Oil-Distributor Bodies for Automobile Engines

The four-station automatic machine shown in the accompanying illustration was recently furnished to a well-known automobile manufacturer by the Bradford Machine Tool Co., 657 Evans St., Cincinnati, Ohio, for use in drilling, spot-facing, and tapping engine oil-distributor bodies. Five Bradford automatic units are mounted on the machine base in various positions. The four-station automatic indexing drum carries cam-actuated fixtures which hold one part at each station.

Control of the machine and synchronization of its movements are accomplished entirely by electrical means through the use of limit switches, solenoids, and relays, most of which are mounted on a control panel built into the machine and protected by a heavy cover. The all-electric control made it possible to use a modification of the Geneva indexing movement which retains the smooth action of this type of mechanism, yet permits the 400-pound, 24-inch turret to be indexed through an arc of 90 degrees in one second without jarring or pounding.

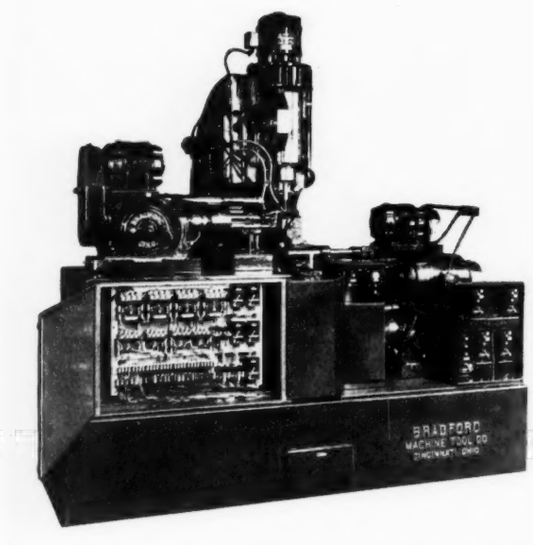
The work is loaded, one piece at a time, at the first station. At the second station, a 1/2-inch hole is drilled 1/2 inch deep, a 3/8-inch hole is drilled 3/8 inch deep, and two 11/64-inch holes are drilled 1/2 inch deep. At the third station, two 21/64-inch holes are drilled through a section 29/32 inch thick, and one 11/32-inch pipe tap hole is drilled 3/4 inch deep. At the fourth station, two 21/64-inch holes are spot-faced 11/16 inch in diameter, and a 1/8 by 27 pipe thread is tapped, using a reversing motor. The production rate with this equipment is 350 parts per hour. 56

"American" Radial Drilling Machine

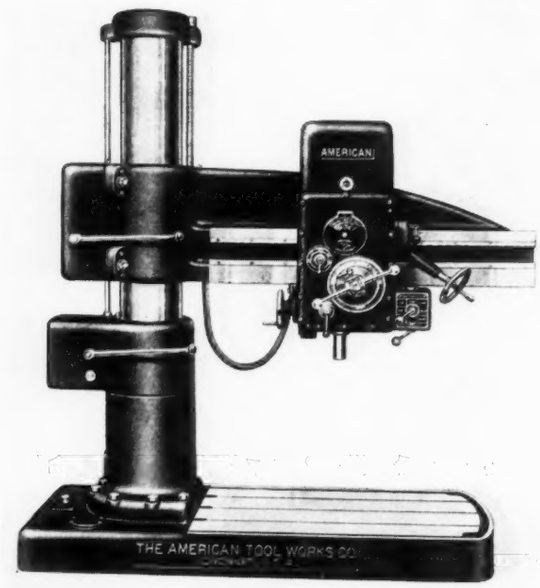
A radial drilling machine known as the "American Super Hole Wizard" has been designed to supplement the recently developed line of this designation brought out by the American Tool Works Co., Cincinnati, Ohio. The new radial drilling machine has a larger column diameter and a longer arm reach than the previous models. The column is 11 inches in diameter, and the four sizes in which this machine is built have arm lengths of 3, 4, 5, and 6 feet.

Nine spindle speeds are available up to a maximum of 3000 revolutions per minute, if desired. A three-horsepower, built-in, rolled-shell type, high-reversal, ball-bearing, alternating-current driving motor is mounted directly on the head of the machine which, through a conveniently located control lever, provides almost instantaneous starting, stopping, and reversing of the spindle.

This machine has been designed to give maximum speed and economy in performing conventional drilling and tapping operations, and to handle the wide variety of accurate boring and spot-facing work encountered in tool-rooms and die shops. The adaptability of the machine for this class of work is one of the



Bradford Four-station Automatic for Drilling Oil-distributor Bodies



Radial Drilling Machine Brought out by the American Tool Works Co.

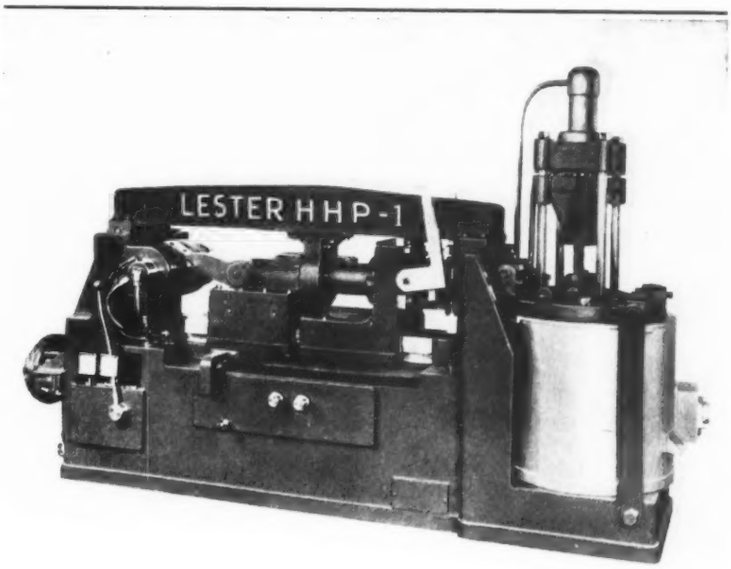
To obtain additional information on equipment described on this page, see lower part of page 562.

outstanding advantages resulting from the new spindle construction. The drive to the spindle is by means of hardened and ground helical gears which provide smooth and quiet power transmission to the spindle even at the highest speeds. 57

Punch Press Control Designed to Prevent Unintentional Operation

A control system for punch presses actuated by air clutches, which is designed primarily to minimize the possibility of accidental operation, has been developed by the General Electric Co., Schenectady, N. Y. This equipment, consisting of a magnetic control panel, a rotating cam type limit switch, and oil-proof push-button stations which provide for continuous stroke operation; one complete stroke of the press; "inching" the press ram down to a point at which the solenoid remains energized and the press automatically completes the stroke; and jogging. 58

General Electric Punch Press Control



Lester Die-casting Machine with Dies Operated Hydraulically through Action of Rotary Cylinder

Lester Die-Casting Machine

The principal features of a die-casting machine recently brought out by the Phoenix Ice Machine Co., 2703-2711 Church Ave., Cleveland, Ohio, are the elimination of frame tie-bars; a die-locking arrangement that insures speedy actuation of toggle links; a self-contained injection cylinder actuator; a pot construction designed to give long life and easy replacement at low cost; a heating furnace independent of the machine; an insulating lining material of increased efficiency; and a hydraulic finger-tip control.

The die is operated by a toggle arrangement, which, in turn, is actuated by a rotary cylinder. This cylinder is internally rotated by hydraulic pressure applied between an internal stationary vane and a movable vane. The latter vane is fastened to the cylinder. A small volume of oil is displaced by this cylinder, resulting in the use of a small pump and motor which delivers a sufficient amount of oil and pressure to maintain a speedy operating cycle. The accumulator for this machine is built into the base.

In changing dies or molds, the die space can be centrally adjusted without misalignment of the die plates. The metal plunger is operated directly by a hydraulic cylinder designed to give a self-adjusting and rapid-injection stroke. The nozzle consists of a heat-resisting material with a simple ball type joint machined on both ends. The die plates are approximately 14 by 14 inches. The capacity of the melting pot is 250 pounds. The maximum die space is 11 inches, and the minimum space 5 inches. The operating speed of this machine is estimated as 1000 shots per hour. The average casting weight is one pound. 59

Harnischfeger Electrode for Welding Manganese Steel

An electrode designated the "Smootharc Harmang," for welding parts subject to heavy impact, such as manganese castings, railroad frogs and crossings, dipper teeth, etc., has been added to the line of Smootharc welding electrodes made by the

To obtain additional information on equipment described on this page, see lower part of page 562.

Harnischfeger Corporation, 4400 W. National Ave., Milwaukee, Wis. The base metal of this electrode is nickel-manganese steel.

The slag coating which stabilizes the arc and protects the metal against loss of carbon and manganese is kept to a minimum to facilitate rapid cooling. Cold-working, such as hammering and peening, causes the soft manganese deposit of this electrode to become an extremely hard layer which resists impact and abrasion. The electrode is made in sizes of from 1/8 to 1/4 inch in diameter for use with currents from 90 to 140 amperes. 60

Warner & Swasey Attachment for Thread Cutting on a Turret Lathe

An attachment that enables the hexagon turret of a ram type turret lathe to be used for cutting accurate threads is being placed on the market by the Warner & Swasey Co., Cleveland, Ohio. The entire attachment, which can be employed for leading on die-heads and taps or for the cutting of threads with a single-point threading tool, is controlled by one operating lever and the regular stop-screws in the end of the turret-slide.

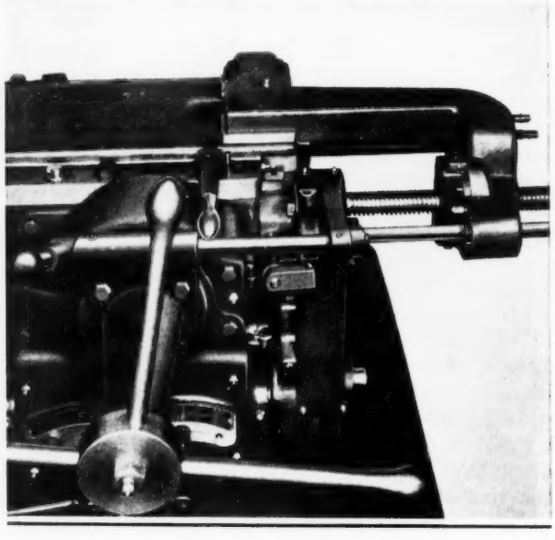
Movement of the control lever first engages the half-nuts with the "leader," and further movement engages the single-tooth clutch at the bottom of the gear-box. This results in rotating the leader and moving the turret-slide at the rate determined by the pitch of the leader. The half-nuts are engaged through a positively actuated cam.

The gear-box attached to the saddle drives the feed-shaft to the leader in a 1 to 1 speed ratio. The range of threads that can be cut with the standard head gear-box is from 4 to 32 threads per inch in any length up to the full effective stroke of the turret-slide. Automatic trip-off of this attachment is accomplished in the same manner as with any other hexagon turret operation by the regular stop roll of the turret-slide. This arrangement does away with any secondary trip-off which must be coordinated with the regular stop to prevent jamming of the unit. The control lever acts as an interlock to prevent the accidental engagement of the longitudinal feed when threading or the engagement of the threading leader when the longitudinal feed is being used. This attachment can be fitted to any No. 3, 4, or 5 current model Warner & Swasey turret lathe. 61

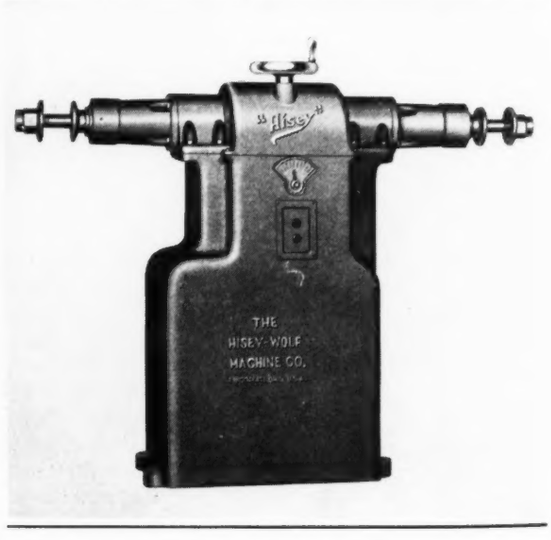
Hisey-Wolf Variable-Speed Buffing and Polishing Machine

Simply turning the handwheel at the top of the variable-speed buffing and polishing machine recently brought out by the Hisey-Wolf Machine Co., Cincinnati, Ohio, gives any desired spindle speed from 1700 to 3500 revolutions per minute. The speed is changed while the spindle is in motion and can also be changed while the machine is actually under a working load. It requires only eleven seconds to change from the extreme low to the extreme high speed, or vice versa.

This machine is made in 3-, 5- and 7 1/2-horsepower capacities, and can be furnished with any NEMA motor for any electrical characteristics. It can also be furnished without the motor, if desired. The speed dial plate at the front of the machine, which is of the direct-reading type, indicates the spindle revolutions per minute. 62



Thread-cutting Attachment Designed for Use on Warner & Swasey Turret Lathes



Hisey-Wolf Buffing and Polishing Machine with Variable-speed Control

To obtain additional information on equipment described on this page, see lower part of page 562.

Ingersoll Six-Spindle Machine for Sawing Caps from Connecting-Rods

A custom-built machine provided with six vertical spindles for sawing the caps from automobile connecting-rods has been completed recently by the Ingersoll Milling Machine Co., Rockford, Ill. This machine will saw off the caps of 500 connecting-rods per hour, producing a slot not exceeding 13/64 inch in width. It consists of a six-spindle traveling head having feed and rapid traverse movements on the base. The front end of the base carries a two-station hand-indexing fixture arranged to hold six connecting-rods in the machining station while six are being loaded and unloaded in the loading station.

Except for loading, unloading, and indexing, the operation of the machine is entirely automatic. The operator loads six rods into the fixture from a box at the side of the machine. He then throws a lever at the front of the machine which withdraws the indexing plungers, turns the indexing handwheel, and throws the lever that brings the indexing plungers back into their locating positions.

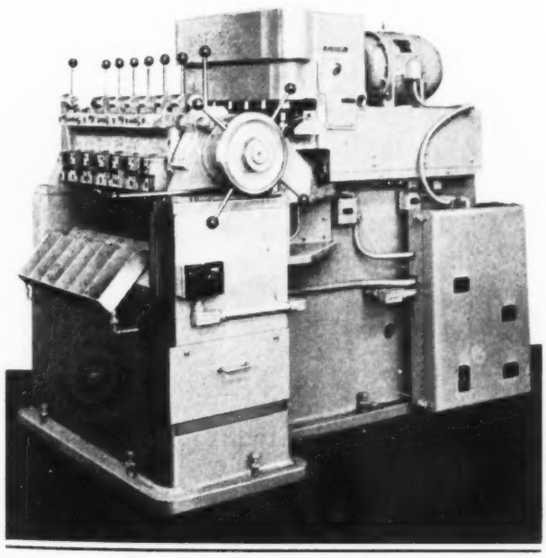
The fixture is arranged to accommodate rods of two different sizes by merely changing the locating blocks at the crank end. Clamping of the rods is accomplished through a cam, one lever being provided for each rod, so that only a slight pressure on the lever is required to securely clamp the work in place. The rods are locked in the fixture from the finish-bored wrist-pin hole, the finished side of the crank end, and the finished surface of one side of the crank bore.

When the fixture is loaded, the operator presses a button and the saddle automatically approaches the work at a fast rate, drops to the feeding rate, feeds the saws through the rods, and automatically returns to the starting position at a fast return speed. While this automatic cycle is taking place, the operator unloads and loads six connecting-rods at the front of the machine. In unloading, both the cap and rods are ejected automatically when the clamp is released and fall into individual trays mounted on the machine. With this arrangement, the caps and the corresponding connecting-rods, which have been drilled in a previous operation, are kept together. 63

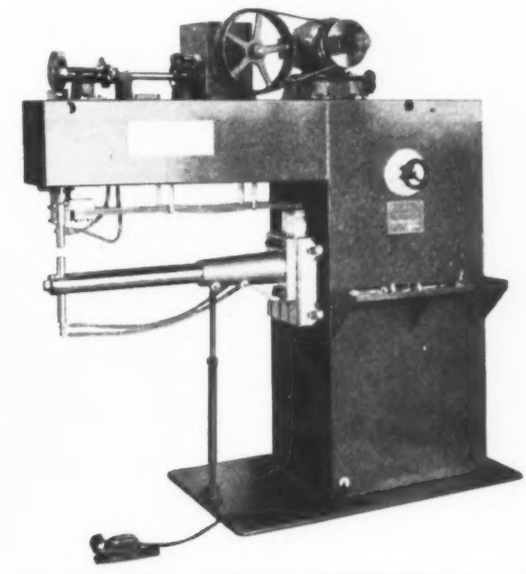
Eisler Spot-Welding Machine

The No. 600-CFO model spot-welding machine shown in the accompanying illustration has just been brought out by the Eisler Engineering Co., 752 S. 13th St., Newark, N. J. This machine has a rated capacity of 75 kilovolt-amperes, but the same design is also made in capacities ranging from 35 to 500 kilovolt-amperes. Except for the driving arrangement, the welding mechanism is completely enclosed in a box type frame. The 3/4-horsepower Reeves variable-speed drive and safety clutch provide a range of 20 to 150 strokes of the upper electrode a minute.

The welder is of the press type, the overhead driving cam giving the upper electrode a straight up-and-down stroke of 1 1/2 inches. The machine can be furnished with any other desired length of stroke. On the same camshaft as the overhead



Ingersoll Six-spindle Machine for Sawing Caps from Connecting-rods



Eisler Engineering Co.'s Spot-welding Machine with Variable-speed Drive

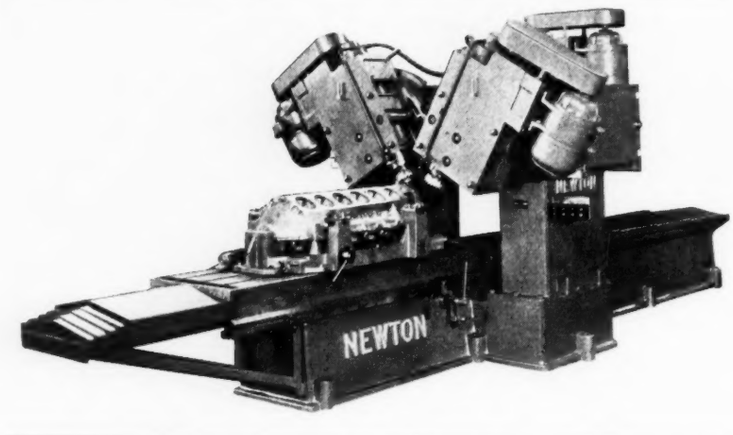
To obtain additional information on equipment described on this page, see lower part of page 562.

driving cam is an additional cam which acts as a timer for regulating the current dwell. This adjustable cam, together with an automatic timer supplied with the contactor, provides sensitive control. The throat depth is 36 inches, but any other throat depth between 12 and 48 inches may be supplied if desired. The electrode-holders are water-cooled. The lower electrode is adjustable both horizontally and vertically. 64

Newton Planer Type Milling Machine for Aluminum Crankcases

The Newton planer type milling machine, equipped as shown in the accompanying illustration for milling three surfaces simultaneously on aluminum crankcases, is one of several similar machines recently built by the Consolidated Machine Tool Corporation, Rochester, N. Y., for various milling operations on large aluminum parts for airplane engines. The other machines perform straddle-milling operations on bearing locks of crankcases and surface milling operations on the top, bottom, and sides of aluminum cylinder heads.

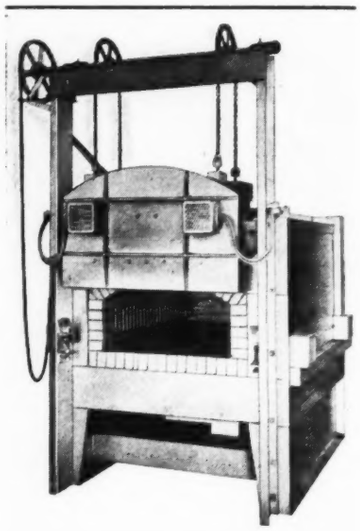
The machine shown has three swiveling unit heads—two on the front cross-girt and one at the rear. The spindle heads are of the Newton patented unit-head type, with individual motors mounted directly on each head. The heads swivel through a wide arc and are also adjustable horizontally on the cross-girt. Adjustable trip-dogs control the rapid traverse and feed through a complete cycle, which stops automatically. Levers for starting the cutting cycle and the rapid return manually are provided at the front and back of the uprights. With these levers, the table can be stopped and started at any point. The machine is also arranged so that it can be unloaded from either end of the bed. The unit-head construction of these machines permits them to be easily modified or rearranged to suit changes in the work. 65



Newton Planer Type Milling Machine Equipped for Milling Three Surfaces of Airplane Engine Crankcases Simultaneously

Lindberg High-Temperature Furnaces

Tubular heating elements which provide circulation, as well as greater radiating surfaces and greater strength, are a feature of the new box and pot type furnaces built by the Lindberg Engineering Co., 224 N. Laflin St., Chicago, Ill. By using tubes as heating elements, the properties of radiation and convection are utilized in these furnaces. These "Tubulaire" elements, as they are called, are simply nickel-chromium tubes which, when heated, act as individual stacks and create definite circulation within the furnace. Thus the furnace temperature is thoroughly equalized, and in addition, continual circulation gives a uniform gas analysis throughout the chamber when special atmospheres are used.



Lindberg Furnace Equipped with "Tubulaire" Heating Elements

Tubulaire-equipped box type furnaces are regularly made in seven sizes having heating chambers ranging from 10 by 18 by 10 inches up to 48 by 96 by 36 inches, with capacities ranging from 10 to 170 kilowatts. The pot type furnaces are made in six sizes, with capacities ranging from 18 to 38 kilowatts and pot diameters ranging from 12 to 24 inches. 66

G E Vacuum-Tube Timer for Machine Applications

A general-purpose, vacuum-tube timer has been announced by the Industrial Department of the General Electric Co., Schenectady, N. Y., for application to industrial machinery, particular-

To obtain additional information on equipment described on this page, see lower part of page 562.

ly machine tools, which require a definite time delay during operation. The electronic portion of the new device consists of a GE-6C5 three-element, high-vacuum metal tube of long life, which can be easily replaced.

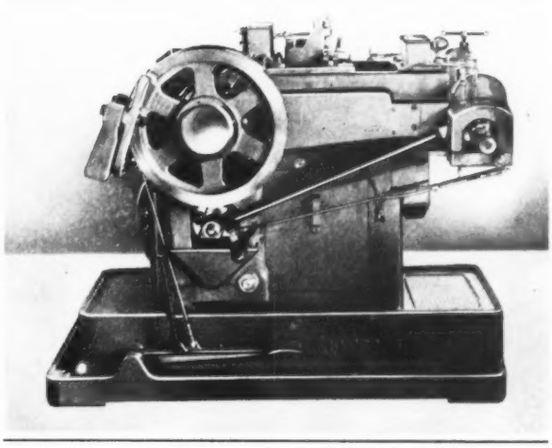
The timer is arranged to operate on either 115 or 230 volts and 50 or 60 cycles. The contact tips are rated at one ampere at 115 volts and 0.5 ampere at 230 volts. The maximum and minimum operating time at 115 volts is approximately sixty seconds and three seconds. 67

Waterbury-Farrel "Hypro" Cold-Heading Machine

A solid-die, double-stroke, crank type, cold-heading machine which strikes two blows per revolution of the flywheel and is designed especially for high-speed and large-quantity production, has been added to the line built by the Waterbury Farrel Foundry & Machine Co., Waterbury, Conn. This machine is suited for the production of high-quality screw blanks and similar headed work, and is built for either belt drive, as shown, or for individual motor drive by multiple V-belts.

There are two standard sizes—the 3/16-inch machine handles work up to 1 inch long under the head, at the rate of 225 pieces, or 450 blows, per minute; and the 1/4-inch size handles work up to 1 1/2 inches long at the rate of 175 blanks, or 350 blows, per minute. Special care has been taken in designing this machine to insure safe and efficient operation at these high operating speeds. The machines are fully guarded, automatically lubricated, and provided with mechanical safety devices.

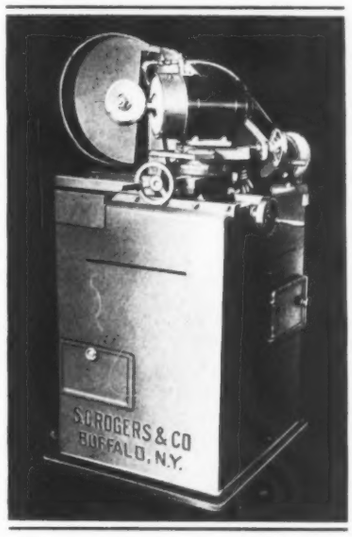
The roll-feed has an auxiliary mechanism which makes it impossible to engage the ratchet and pawl manually except at the start of the forward feeding movement. Thus it is impossible to feed a short length of wire into the heading dies. The device that cuts off the wire and transfers the blank into the heading position can be properly adjusted for timing and location of the knife relative to the dies. The heading unit includes the horizontal reciprocating gate, the vertical reciprocating punch-slide, and the knock-out device which takes the heading thrust and ejects the finished work. The 3/16-inch belt-driven machine occupies a floor space of 32 by 56 inches and weighs 3300 pounds. The 1/4-inch machine requires a floor space of 50 by 66 inches and weighs 6600 pounds. 68



Waterbury-Farrel "Hypro" Double-stroke Cold-heading Machine

McKay Welding Electrodes

A complete line of shielded-arc welding electrodes developed with the object of giving quieter operation, faster welding time, finer bead appearance, and a wider range of adaptability per rod has been brought out by the McKay Co., McKay Bldg., Pittsburgh, Pa. Although the new electrodes are of an improved type, no changes in the usual welding procedure are required. 69



Rogers Grinding Machine for Sharpening Circular Knives

Rogers Circular-Knife Grinding Machine

A circular-knife grinding machine for sharpening slitter knives and circular disks has been brought out by Samuel C. Rogers & Co., 191-205 Dutton Ave., Buffalo, N. Y. This CC3 machine will grind solid or split type disks of any size from 2 to 20 inches in diameter, and of any thickness, with either single or double bevel or flat faces. A motor revolves the knife being ground, which is held in an interchangeable arbor fastened in the drive spindle. The spindle is driven by a V-belt, using a sheave which can be adjusted to give the proper peripheral speed.

A motor-driven wet grinding attachment with suitable splash guards consists of a built-in two-step coolant tank equipped with a centrifugal pump. Regular equipment includes a 1/3-horsepower motor having a speed of 3600 revolutions per minute for driving the wheel, and a 1/3-horsepower motor for driving the knife spindle and water pump. 70

To obtain additional information on equipment described on this page, see lower part of page 562.

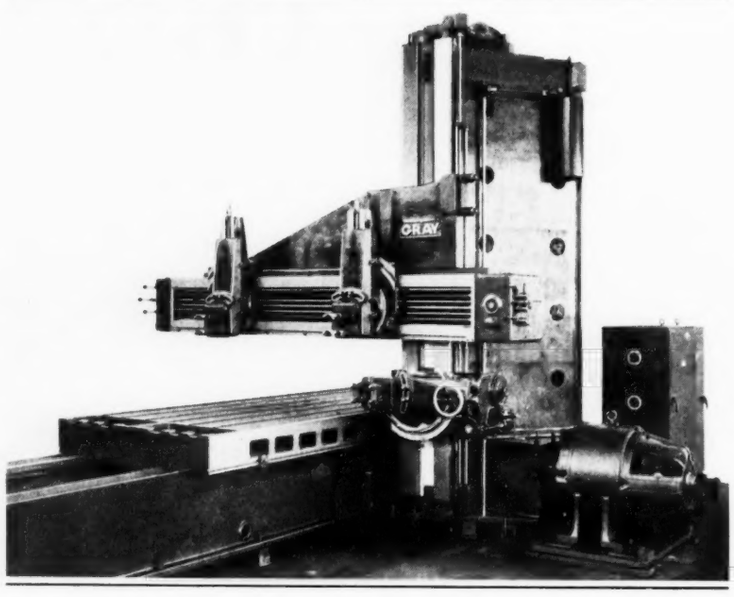
Gray Open-Side and Double-Housing "Maximum Service" Planers

A "Maximum Service" planer built in open-side and double-housing types by the G. A. Gray Co., 3611 Woodburn Ave., Cincinnati, Ohio, has been so designed that even the largest size machine can be operated easily and rapidly. It can be set by one operator to do precision work, and is especially equipped to permit successful operation by men having comparatively little training. A new patented control makes it possible to engage or disengage the feed or to traverse the heads rapidly in either direction by means of a single lever.

Operating levers are located at both ends of the rail and also at each head. The feed and rapid traverse are so interconnected that it is impossible to engage both the feed and rapid traverse of any one head at the same time. The feed and rapid traverse are independent of each other, so that one head can be traversed rapidly while the feed of any other head is engaged.

A manually operated precision tool-point locator can be furnished for the rail-heads. The tool-point locator makes it possible to move the saddle or slide by hand at the head itself instead of from the end of the rail. This eliminates the necessity for having a helper to operate the crank at the end of the rail when making precision settings.

The side-head feed and rapid traverse is operated by a single directional lever located on the head itself. When power in-and-out feed and rapid traverse is furnished, this lever also actuates the slide. Extended saddles on all heads provide an additional long-leverage bolt circle. The rail can be raised or lowered by pressing a push-button on a pendent type control station. After lowering the rail, it is automatically raised a fraction of a notch, so that all backlash in the elevating mechanism is taken up before the rail is clamped. 71

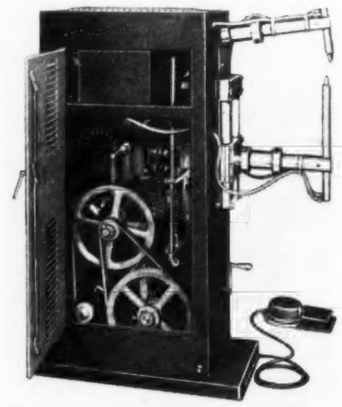


Gray "Maximum Service" Planer Made in Open-side and Double-housing Types

Ace Motor-Driven Automatic Spot-Welders

A new series of automatic spot-welders, designed to give increased output with less operating effort, is being brought out by the Pier Equipment Mfg. Co., 807 Cross St., Benton Harbor, Mich. The principal features of these welders include a Reeves vari-speed transmission having a 3 to 1 ratio of speed variation; mechanical weld-timing control, whereby the welding time can be set to as fast as 1 1/2 cycles or one-fortieth of a second; precision of pressure application; and accuracy of timing.

These welders are made in four sizes—15, 20, 30, and 50 kilowatts. The same size welder will handle material from 0.005 inch thick up to two thicknesses of eight-gage stock. The welding capacities of these four series are based on welding materials at their maximum speed of 120 strokes per minute. 72

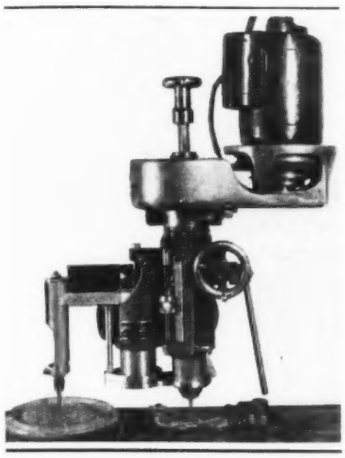


Ace Spot-welder with Speeds of 40 to 120 Welds per Minute

"Hydra-Speed" Duplicating Attachment for Eklind Milling Head

A "Hydra-Speed" hydraulic duplicating attachment has just been placed on the market by the Universal High Speed Tool Co., 549 W. Washington Blvd., Chicago, Ill., for use on the Eklind universal milling, drilling, and boring head. The hydraulic attachment to this duplicating unit is being manufactured for this company by the Hydraulic Dup cator Co., Detroit, Mich.

To obtain additional information on equipment described on this page, see lower part of page 562.



Eklind Milling Head Equipped with Duplicating Attachment

With this equipment, smooth vertical motion is imparted hydraulically to the milling-head cutter-spindle at the exact rate required to follow the contour of the model or templet being reproduced. The "Hydra-Speed" duplicator can be detached from the milling head, thus making the milling attachment available for plain milling, drilling, and boring. The duplicator is designed for use on the average range of work in small and large die shops, such as making Bakelite, plastic, rubber, and drop-forging molds and dies. 73

De Walt Metal-Cutting Machine

The Type GE metal-cutting machine here illustrated is the latest equipment of this kind to be added to the line made by the De Walt Products Corporation, Lancaster, Pa. The machine can be provided with a 5- or a 7 1/2-horsepower motor operating at 3600 revolutions per minute for sawing steel, or with a 5-horsepower motor operating at 1800 revolutions per minute for sawing aluminum, copper, soft brasses, and white metal alloys.

An anti-friction mounted carriage, riding inside the arm, supports the motor, to the shaft of which the saw is directly attached. Foot-operated vises are employed to hold the material. A detachable chain feed gives the operator an increased leverage, which enables him to feed the saw steadily into the material.

This machine has a capacity for cutting chromium-molybdenum alloy steel tubing up to 3 1/2 inches in diameter with a wall thickness under 1/16 inch, or 2-inch tubing with a wall thickness of 1/8 inch; and solids up to 1 1/2 inches thick. 74

Colonial Pull-Down Type Broaching Machine

A pull-down type broaching machine for broaching the kingpin holes in front axles or for similar light broaching operations on small or large work has been brought out by the Colonial Broach Co., 147 Jos. Campau Ave., Detroit, Mich. In the axle-broaching operation, the work is placed on the two plates shown on top of the machine table. These plates are provided with simple locating fixtures without clamping devices. The broach is inserted from the top through the hole in the work and the faceplate into an automatic puller. The broaches are pulled through the work, the work is removed, and the machine returns the broach, the puller releasing it at the top of the stroke. This hydraulically operated machine has a capacity of 5 tons and an 18-inch stroke. 75

Machine for Rapid Sawing of Light-gage Metals

Colonial Pull-down Type Broaching Machine

To obtain additional information on equipment described on this page, see lower part of page 562.

Internal Grinding Attachment for Cincinnati Universal Grinding Machine

A motor-driven internal grinding attachment that can be permanently fixed to the machine and hinged at the front of the grinding wheel head to permit rapid and accurate setting up has been developed for the 12- and 16-inch universal grinding machines made by Cincinnati Milling Machine and Cincinnati Grinders Inc., Cincinnati, Ohio. This attachment can be set up by merely swinging the spindle housing down and tightening one bolt. It is always in accurate alignment, as the swivel setting of the wheel-head remains the same for both straight external and straight internal work. Jobs requiring external and internal grinding can be accommodated without removing the work from the chuck.

The attachment is driven by an individual motor rated at two horsepower, which is mounted on a cover plate at the top of the wheel-head unit. The internal spindle housing is hinged at the front end of the plate on an adjustable anti-friction bearing hinge. When the attachment is swung down into the working position, a single hinged bolt clamps it firmly to a machine pad in front of the wheel-head casting.

An endless flat belt drives the attachment spindle. This belt may be left on the pulleys for convenience when the attachment is swung up and out of the way to permit external grinding. A heavy tension spring holds the attachment in the upper or non-working position.

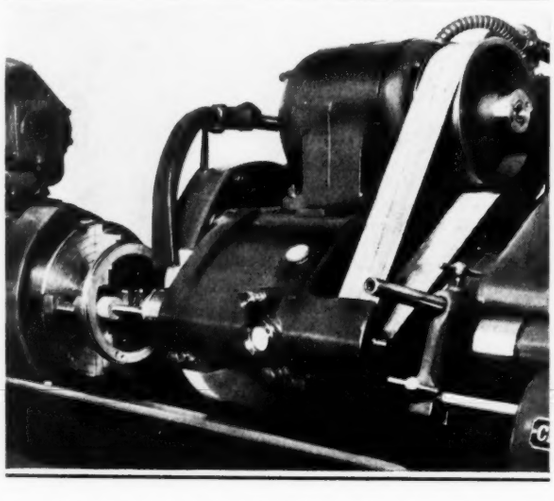
This internal grinding attachment has a capacity for grinding holes or bores ranging from 5/16 inch to 4 inches in diameter by 1 1/2 to 6 1/2 inches deep, using wheels from 1/4 inch to 2 inches in diameter, depending upon the spindle employed. Any one of seven different spindles may be specified. The speeds also depend upon the spindle chosen, varying from 10,000 to 18,000 revolutions per minute. 76

Landis Floating Carriage Front for "Landmaco" Threading Machines

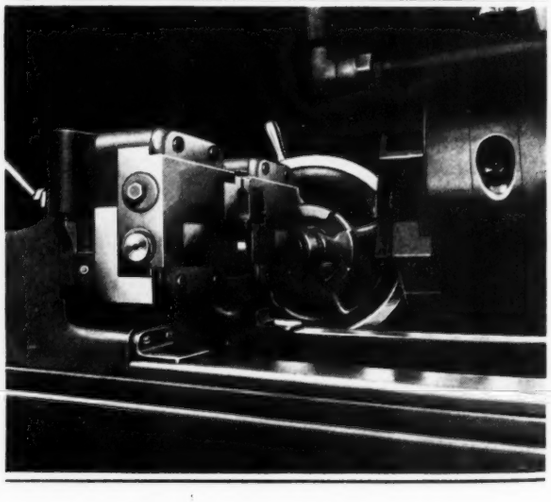
The Landis Machine Co., Inc., Waynesboro, Pa., has recently developed a new carriage front or vise which can be supplied as optional equipment on the "Landmaco" threading machine. This carriage front is a combination floating unit, which compensates automatically for any misalignment of the work with the die-head, and a special vise jaw operated by a handwheel, which delivers a hammer-like blow to effect the gripping or releasing of the work with minimum effort.

The vise on the floating carriage is so mounted on a series of three plates as to provide both a horizontal and a vertical floating action. This mounting maintains the vise in a centralized position, except when forced off center by misalignment between the die-head and the work. The entire unit can also be adjusted horizontally or vertically in relation to the center of rotation.

The "hammer-blow" handwheel, which is designed for use with the floating front carriage, but is applicable to standard carriage fronts, greatly reduces the effort required to grip the work and to open a vise that has been rigidly locked. The handwheel is of the flywheel type and is free to rotate in an arc of 45 degrees on the vise screw. When the handwheel is spun or rotated rapidly, a sharp blow is delivered by lugs on the knocker arm, and since the full flywheel effect of the handwheel is obtained, the work is readily gripped or easily released. 77

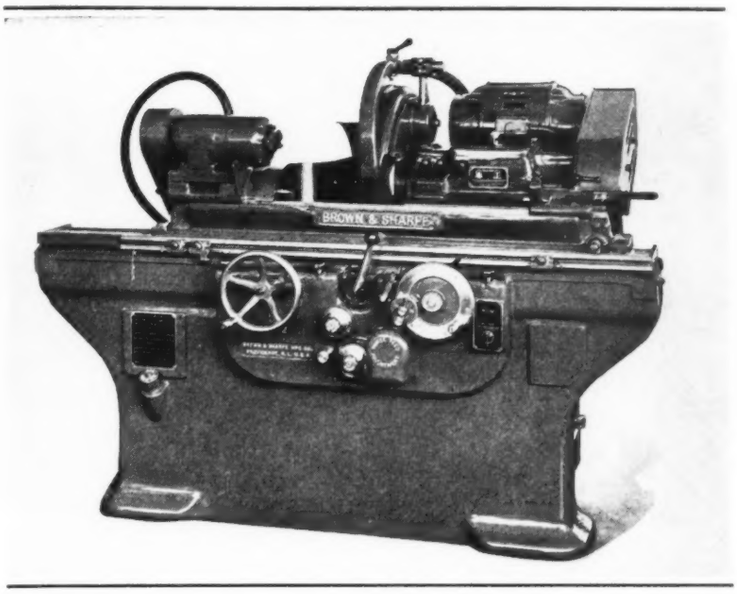


Cincinnati Grinding Machine Attachment in Position for Internal Grinding



Floating Carriage Front for "Landmaco" Threading Machines

To obtain additional information on equipment described on this page, see lower part of page 562.



Brown & Sharpe No. 12 Plain Grinding Machine

Brown & Sharpe Plain Grinding Machines with Electric-Hydraulic Controls

The new No. 10 and No. 12 plain grinding machines recently announced by the Brown & Sharpe Mfg. Co., Providence, R. I., are designed for the rapid cylindrical grinding of small and medium sized parts to close limits. They have hydraulic table drive and hydraulically actuated cross-feed, and are operated by a simple arrangement of hydraulic and electrical controls.

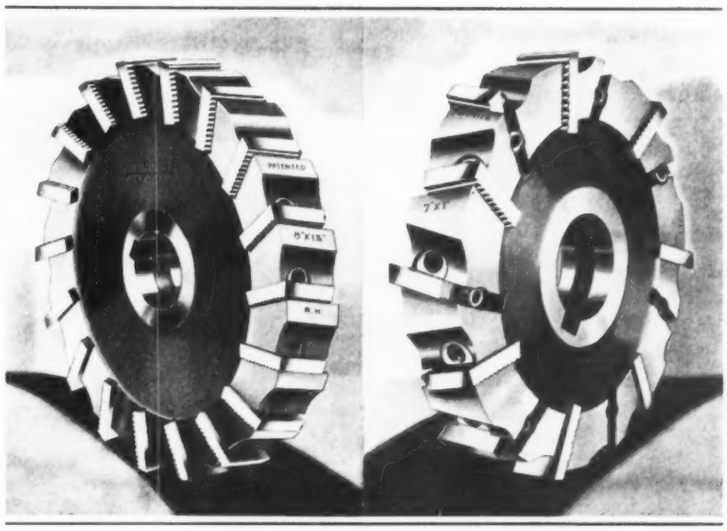
The wheel-spindle, headstock, hydraulic pump, and coolant pump have individual motor drives. The built-in electrical control system simplifies the set-up for wheel truing; provides headstock "jog" to facilitate loading and unloading work; permits stopping the coolant pump for observing the work during grinding; and in using handwheel control, permits starting and stopping the headstock and coolant pump automatically when the cross-feed handwheel is turned to advance and withdraw the grinding wheel.

Any rate of travel from 7 to 360 inches per minute can be selected while the machine is running. An adjustable dwell is provided which ranges from 0 to 3/4 second at each reversal. Hand travel is also available, the handwheel being disengaged automatically when the power travel is engaged. The cross-feed ratchet and pawl mechanism is actuated from the hydraulic system, both on reversal of the table and continuously for plunge-cut grinding. The feed is governed by the setting of a crank, and a dial on the cross-feed handwheel permits adjusting the automatic throw-out to 0.0001 inch on the work diameter.

The work size capacities are 6 by 18 inches for the No. 10 machine and 6 by 30 inches for the No. 12. On both sizes, the centers swing 6 11/16 inches over the table. 78

McCrosky Jack-Lock Side Milling Cutters

Half-side and staggered-tooth side milling cutters have recently been added to the line of Jack-Lock inserted serrated-blade milling cutters made by the McCrosky Tool Corporation, 1340-70 Main St., Meadville, Pa. These new styles of cutters have the patented features incorporated in all standard Jack-Lock cutters, including wedges for locking the blades; individual adjusting screws threaded into the body behind the blades; "Tru-ground" serrations, which are ground in all blades from the solid after hardening. Standard cutters in both of the styles shown in the illustration are furnished in a range of diameters and widths suitable for a wide variety of work. Cutters with tungsten-carbide tipped blades are furnished to order. 79

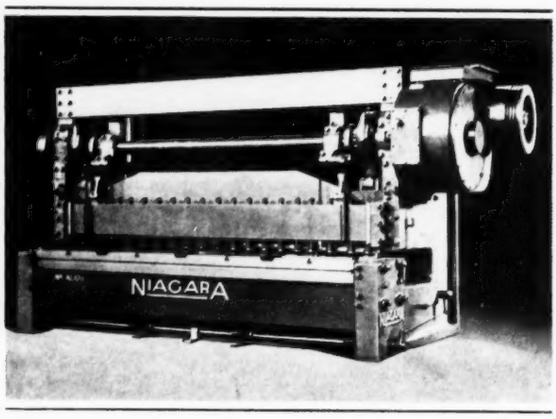


(Left) McCrosky Jack-Lock Half-side Milling Cutter
(Right) Jack-Lock Staggered-tooth Side Milling Cutter

To obtain additional information on equipment described on this page, see lower part of page 562.

Niagara Power Squaring Shears

A new line of Series KL power squaring shears has recently been added to the products of the Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y. Squaring shears built in 6-, 8-, 10 1/2-, and 12-foot lengths for flat shearing of 3/8-inch steel, and in 14- and 16-foot lengths for 1/4-inch steel, are included in this new line. These shears have triangular-section cross-heads with a low slope, as shown in the accompanying illustration; box-section beds; enclosed drives running in oil, with the gears mounted on anti-friction bearings; fourteen-point engagement sleeve clutch, with built-in single-stroke mechanism; self-measuring parallel back gage with ball bearings; and alloy-steel knives. 80



Niagara Power Squaring Shear

H & G Self-Opening Die-Heads

A new H & G self-opening die-head has been developed by the Eastern Machine Screw Corporation, 23-43 Barclay St., New Haven, Conn., for cutting taper pipe threads on automatic screw machines in which the die-head rotates. This die-head, designated Style TMM, has been designed to produce high-quality threads. The No. 101 size, shown in the illustration, is only 2 7/8 inches in diameter and is suitable for cutting 1/8-, 1/4-, and 3/8-inch pipe threads.

This style of head is intended as a companion tool for the Style TM taper cutting head used for threading pipe fittings. The chasers in both styles of die-heads recede at a definite rate, so that the taper is accurately controlled. The tapering action in the new die-head is effected by a yoke on the machine, whereas in the Style TM head, the tapering action is effected by an inside plunger in contact with the end of the work. 81

Improved Bruning Printing Machine

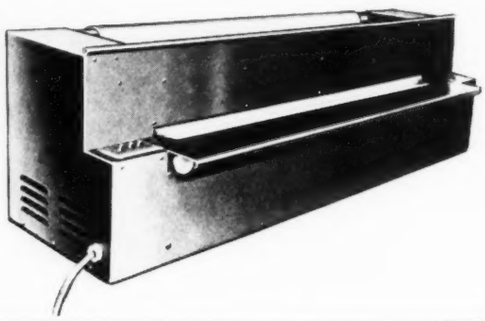
Improvements in both mechanical and electrical equipment have been incorporated in a Model 4 printing machine for making blue, black, and white prints, which has recently been brought out by the Charles Bruning Co., Inc., 100 Reade St., New York City. This machine is of the continuous type, the tracings and paper being carried on a heavy endless canvas band past a curved contact glass, inside of which are mounted two new-style long-life mercury vapor tubes which provide the required illumination for exposing the print.

The advantages of this machine over previous models are greater light output per watt, and light that is more efficient for printing; an increase of approximately 50 per cent in the printing speed; and positive control of the band speed within the operating range of from 2 to 30 inches per minute. The machine is designed for making prints up to 42 inches wide. 82

Fractional-Horsepower Motors for Air-Circulating Fans

A line of motors with housings especially shaped to offer the least possible resistance to the flow of air when used with air-circulating fans has been placed on the market by the Ohio Electric Mfg. Co., 5929 Maurice Ave.,

H & G Self-opening Die-head for Pipe Threading

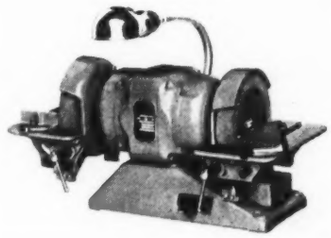


Bruning Printer with Improved Equipment

To obtain additional information on equipment described on this page, see lower part of page 562.

Cleveland, Ohio. These motors are built with split-phase windings to operate at 1150 or 1725 revolutions per minute with a start and stop pull type switch; also with windings for two speeds, 860 and 1140, or 1140 and 1725 revolutions per minute, controlled by a three-position pull switch. They are also built to operate with a separate transformer-capacitor control to run at two or three different speeds, including combinations of 1150, 1725, and 860 revolutions per minute.

These motors are made in 1/8-, 1/6-, or 1/4-horsepower sizes to operate fans from 20 to 32 inches in diameter. They can be furnished with either a smooth or crackle enamel finish. 83



Baldor Tool Grinder of Improved Design

Improved Baldor Grinder for Carbide Tools

The Baldor Electric Co., 4400 Duncan Ave., St. Louis, Mo., announces several improvements in the construction of the carbide tool grinder described in November, 1937, MACHINERY, page 222. The standard equipment of this grinder now includes a protractor type tool support, which indicates the angle at which the tool is being ground.

The tool-rest tables of the new machine are adjustable so that they can be moved toward the wheel as the diameter of the wheel is reduced by wear. 84

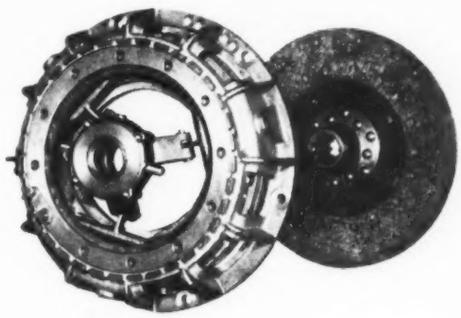


Fig. 1. Rockford "Over-Center" Ball-bearing Clutch

Rockford "Over-Center" Clutches Equipped with Roller Cams

The "Over-Center" type clutches made by the Rockford Drilling Machine Division of Borg-Warner Corporation, 301 Catherine St., Rockford, Ill., are now being equipped with anti-friction roller cams. These cams, arranged to apply a heavy pressure uniformly over the entire clutch face, operate in the manner indicated in Fig. 2. This arrangement contributes to long-time operation without adjustments and also makes the clutches extremely easy to operate. The hardened and ground rollers bear upon hardened steel inserts in the pressure plate and on the hardened adjusting ring plate.

The "Over-Center" clutches, one model of which is shown in Fig. 1, are made in many different sizes, the faced driven members ranging from 7 to 20 inches in diameter. The capacities of the standard single-plate clutches range from 160 to 2000 foot-pounds torque, or 3 to 38 horsepower per 100 revolutions per minute. Double-plate clutches having greater capacities for corresponding diameters are also made. The clutches are equipped with operating collars that may be provided with either bronze bearings or ball bearings, according to requirements.

The spring steel adjusting ring plate yields slightly as the roller cams pass over the center, thus relieving the back plate of strains and introducing a spring-loaded effect which holds the clutch firmly in engagement. The hard surface and floating action of the adjusting ring plate help to eliminate wear. Fine adjustments are maintained by simple, positive locking means, located near the outer diameter of the clutch and readily accessible through a hand-hole in the bell housing or cover.

These clutches are being used to advantage in connection with gasoline or Diesel engine drives for agricultural machinery, concrete mixers, cranes, compressors, excavators, pumps, oil-field equipment, tractors, road-building machines, and similar equipment. 85

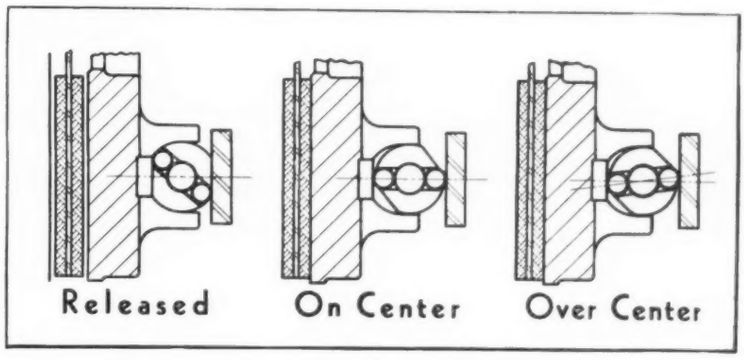


Fig. 2. Diagrams Indicating Action of Roller Cams Used to Engage Clutch Shown in Fig. 1

To obtain additional information on equipment described on this page, see lower part of page 562.

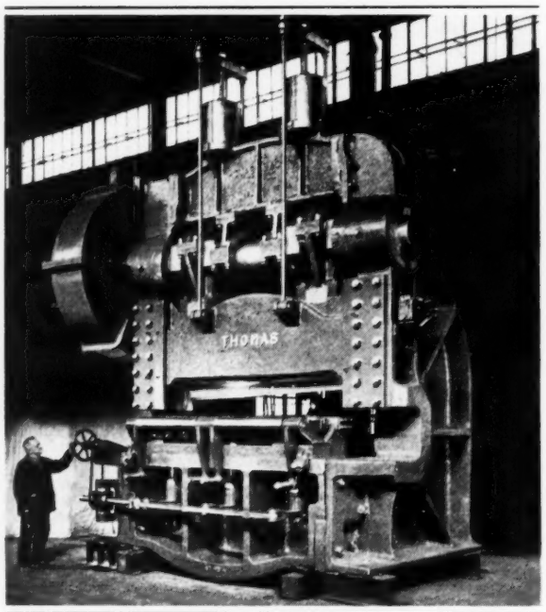


Plate Shear Made by Thomas Machine Mfg. Co. for Shearing Aluminum Alloy Slabs

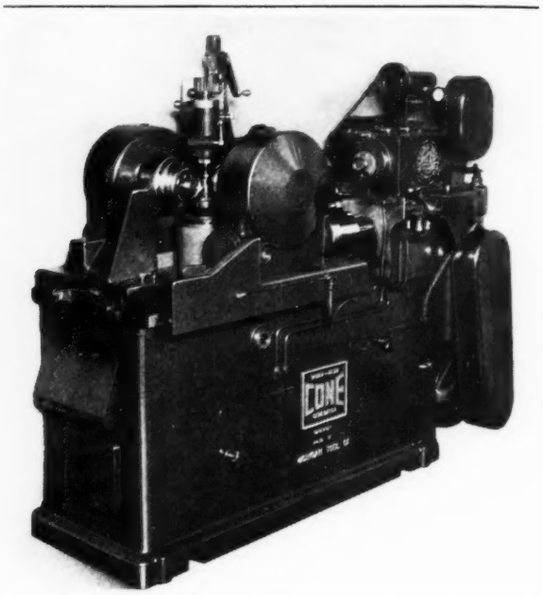


Fig. 1. Gear Generator Built by Michigan Tool Co. for Mass Production of Cone Gears

Thomas Plate Shear for Aluminum Alloy Slabs

The No. 22 plate shear brought out by the Thomas Machine Mfg. Co., Butler Plank Road, Pittsburgh, Pa., especially for shearing aluminum slabs has been designed to promote safety, durability, and smooth operation. It has a capacity for shearing slabs up to 2 inches thick by 78 inches wide as the material comes from the mill. The 12-inch stroke allows an ample opening under the upper knife to clear curled material. The lower knives have a special arrangement by means of which they can be quickly adjusted to accommodate material of different thicknesses.

The herringbone gears used in this machine are completely enclosed in a welded gear-case. The motor drive is by means of V-belts. The clutch is operated by air through an electrically controlled valve operated by a push-button. The ram is counterbalanced by means of air cylinders. 86

Michigan Automatic Gear Generator

The Michigan Tool Co., 7171 E. McNichols Road, Detroit, Mich., has developed a line of automatic gear generators designed for the mass production of "cone" type area contact worms and worm-wheels. These new automatic machines can also be used for cutting other types of gears. In finishing cone worm-gearing, both worms and wheels are machined with the generating cutter and work at the exact operating center distance. To achieve this, the machining of either worms or wheels—with mating generating cutters—is actually performed in two steps. In the first or roughing operation, a narrow-blade generating cutter or hob is fed into the blank until the required center-distance position is reached.

In the finishing part of the operation, there is a differential rotary feed—similar to the taking up of backlash in gearing. With this rotary feed, the cutter blades shave material off the faces of the worm and wheel teeth until the teeth are finish-sized. This action is made possible by the design of the gearing. The teeth are not involute, but are generated by straight lines, all tangent to the base circle about the mating worm or wheel cone gearing. The new machines are designed to take care of gearing up to 4 inches center distance, with wheels up to 7 inches in diameter and worms up to 3 inches.

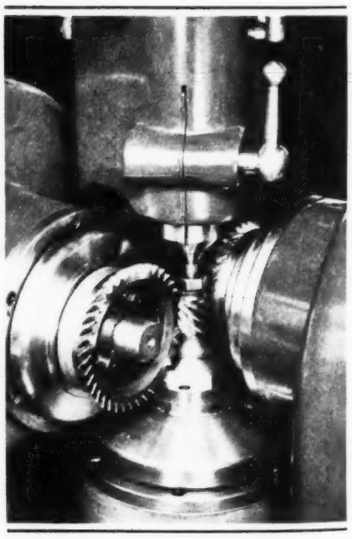


Fig. 2. Close-up View of Cone Gear Cutting Operation

To obtain additional information on equipment described on this page, see lower part of page 562.

When the machine is in use, the operator merely drops the part into the work-spindle, throws off the air chuck, and pushes the master starting button. After the in-feed cycle is completed, there is a short dwell and then a rapid return to the loading position, the limit switch stopping the machine for reloading. The machines for worms and wheels operate identically, the hobs being substituted for the cutters on the cutter-spindles, while the worms are placed on the work-spindle. 87

Hanna Portable Pneumatic Riveter

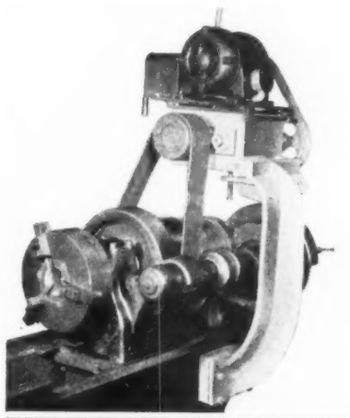
A light-weight, portable pneumatic squeeze type riveter for setting 1/4- and 5/16-inch rivets cold has been developed by the Hanna Engineering Works, 1765 Elston Ave., Chicago, Ill. This machine can be used for setting vertical rivets or for driving horizontal rivets. The complete machine weighs less than 100 pounds, and may be suspended from a balancing arrangement designed for vertical movement.

A universal suspension bail permits the riveter to be tilted from side to side so that it can be used in any position. The operating valve in the rear cylinder head is used to guide the riveter. After completing the power stroke, the valve automatically reverses, returning the dies to the open position, ready for the next rivet. The riveter operates at a speed of 50 strokes a minute. 88

Hanna Squeeze Type Pneumatic Riveter

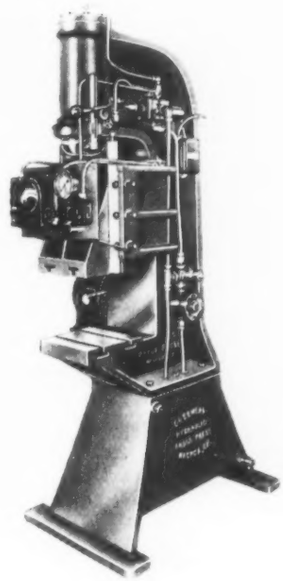
Four-Speed Motorization Units for Machine Tools

The Production Equipment Co., 5219 Chester Ave., Cleveland, Ohio, is bringing out a motor driving unit designed to motorize belt-driven machine tools. This drive has a four-speed, quick-change gear-box driven by a motor having a speed of either 1800 or 1200 revolutions per minute. With this equipment, no belt shifting is required, as speed changes are handled by the gear-box. A large range of open-belt spindle speeds can be secured by the use of two-speed motors.



Motorization Unit for Machine Tools

A special assembly can be furnished, in which a single-speed motor is used, with the gear-box output shaft coupled to the countershaft cone pulley. With this assembly, a three-step cone gives twelve different spindle speeds. Supports can be supplied for mounting the drive above or at the side of the machine. 89



Greenerd 15-ton Plastic Molding Press

Greenerd Plastic Molding Press

A 15-ton, light plastic hydraulically operated molding press, equipped with an automatic electric time cycle and ram control, is being built by the Greenerd Arbor Press Co., Nashua, N. H. The hydraulic pump is driven by a five-horsepower motor. A "stop-start-jog" station and a process timer with a range of from 1/2 to 6 minutes are located at the front of the press. There is also a direct-reading pressure gage and an emergency stop station.

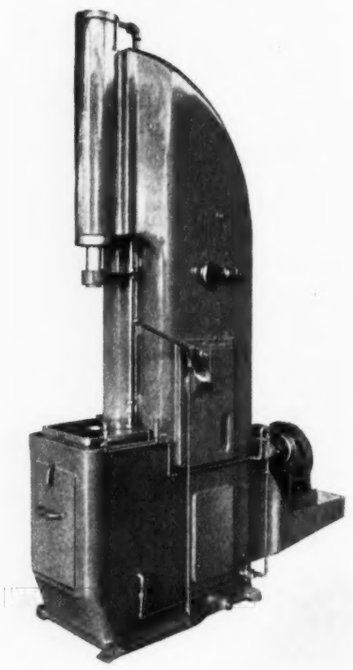
The working table is 12 by 12 inches, the distance from center of ram to back of throat is 9 1/2 inches, and the distance from back of cross-head to throat is 3 1/2 inches. When at its highest point, the head is 12 inches above the working table. The ram has a stroke of 6 inches and a maximum up-pull of 13 tons. Any desired pressure on the down stroke from 1/2 to 15 tons can be obtained by making the proper setting. The hand control is automatically disconnected when the current is on. 90

To obtain additional information on equipment described on this page, see lower part of page 562.

Vertical Assembling and Broaching Presses

A Type V-2 press for broaching, pressing, and assembling work has been brought out by the American Broach & Machine Co., Ann Arbor, Mich., in 6- and 12-ton sizes. The work-table of this machine is built integral with the vertical column. The table is square and is equipped with a removable steel top plate, which is finished on the surface for the application of work-holding fixtures for internal and external broaching, as well as for pressing and assembly work.

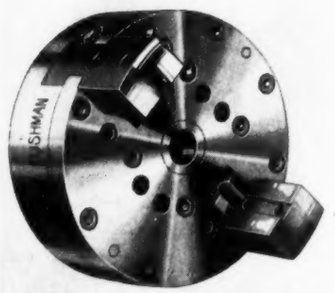
The ram movement is controlled by a hand-lever or a foot-pedal. Either control permits the operator to advance the ram slowly or rapidly, or it can be "inched" along by varying the pressure. Automatic stops are provided, which consist of two collars on the machine control rod. These collars are adjustable and can be set for stopping the machine at any predetermined point. Although rated at 6- and 12-ton working capacities, the maximum capacities of these presses are 9 and 14 tons, respectively. Both machines have a maximum stroke of 26 inches. The bore in the rest plates is 3 inches in diameter. 91



Broaching Press Brought Out by American Broach & Machine Co.

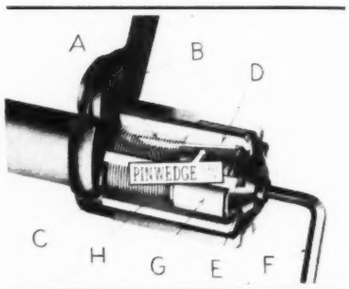
Cushman Two-Jaw Precision Chuck

A two-jaw chuck of the precision type, designed for accurate centering of precision work, as well as for use on production jobs, has been brought out by the Cushman Chuck Co., Hartford, Conn. The principal features of this chuck include a one-piece steel body with hardened steel face in which the jaws are enclosed; a hardened alloy steel operating screw held by a self-aligning thrust bearing which completely encircles the neck of the screw and assures accurate alignment with the mating teeth of the master jaws; and jaws with wide bearing surfaces. The jaws are also supported in the center, under the face.



Cushman Precision Type Two-jaw Chuck

The master jaws are of the American Standard design, and the soft top jaws, when attached, form a seal on the hardened body face which completely encloses all operating parts. This chuck is available in a full range of sizes for direct mounting on American Standard spindles, and can be attached to the threaded type spindle nose by means of an intermediate plate. 92



Barber-Colman Adjustable Reamer

Barber-Colman "Masterall" Reamer

An expansion reamer designated "Masterall" that can be adjusted to size by hand within 0.0005 inch without removing it from the machine has been developed by the Barber-Colman Co., Rockford, Ill. This reamer is made in both shell and shank types and is provided with this company's standard high-speed steel or carbide-tipped blades, as shown at *H* in the accompanying illustration. The straight and tapered shank types are regularly made in sizes ranging from 13/16 inch up to 3 inches in diameter, while the shell type is made in sizes from 1 1/2 to 3 inches.

Referring to the illustration, the bottom of the blade is ground to correspond to the taper of the bottom of the slot at *A* in the body *G*, so that lengthwise movement of the blade produces expansion or contraction. Adjustment is obtained by means of a spanner wrench *B*, which is used to turn the adjustment collar *C*. The blades are locked in place by pin-wedges *D*, which are pressed back into their clamping positions by the locking plate *E* when the clamping set-screw is tightened by wrench *F*. 93

Imperial Pulley and Flywheel Puller

A compact pulley and flywheel puller weighing only 2 1/2 pounds, which is adapted for pulling either from the spokes or from the outside of the wheel,

To obtain additional information on equipment described on this page, see lower part of page 562.

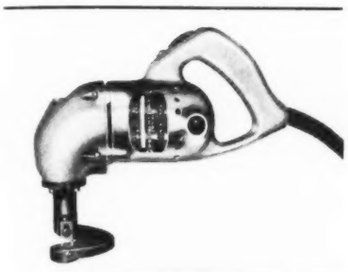


Fig. 1. Black & Decker "Lectro-Shear"

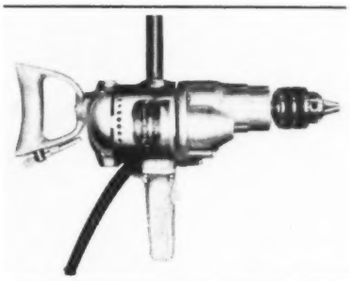


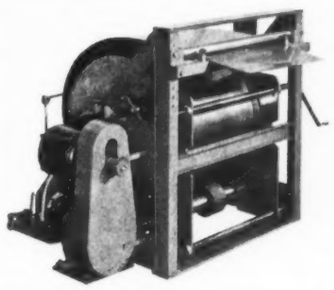
Fig. 2. Black & Decker Utility Power Drill

has been placed on the market by the Imperial Brass Mfg. Co., 1200 W. Harrison St., Chicago, Ill. This device can be used for pulling spoked wheels of any size having hubs that are less than 3 inches in diameter and are within the depth reach of the puller. It can be used for pulling solid wheels and gears of any size up to 7 inches in diameter. 94

Black & Decker Portable "Lectro-Shears" and Utility Power Drills

A portable electric tool known as the "Lectro-Shear," which is designed to cut all types of sheet metal quickly and accurately, has been added to the line of equipment made by the Black & Decker Mfg. Co., Towson, Md. The shearing action is accomplished by the rapid reciprocating movement of a vertical blade against a stationary horizontal blade. The horizontal blade is set in a special shoe designed to indicate the correct cutting angle. This shear will cut on a radius as small as 3/4 inch, and can be easily guided along a straight or patterned line. It is made in two sizes, having capacities for cutting 16- and 18-gage steel.

A Utility power drill, made in 5/8-, 3/4-, and 7/8-inch sizes, is the latest addition to the line of portable electric drills made by this company. These drills are designed to provide sufficient power for any drilling job within their capacities and have spindle speeds which adapt them for utility service, such as drilling with carbon bits, driving wood augers, cutting with hole saws, operating cylinder hones and grinders, drilling in hard-alloy metals, and performing heavy-duty precision work in a bench drill stand. 95



Littell Motor-driven Variable-speed Reel for Coil Stock

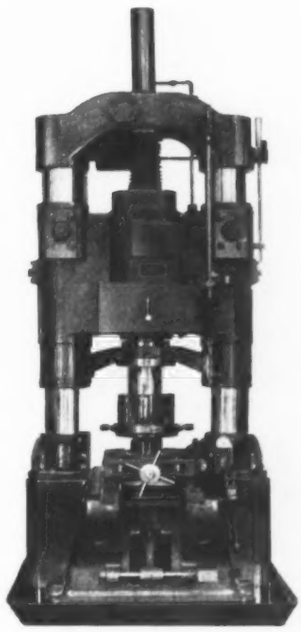
Littell Motor-Driven Variable-Speed Coil Reel

A motor-driven variable-speed cradle reel, designed for accurate feeding of coil stock, has been brought out by the F. J. Littell Machine Co., 4149 Ravenswood Ave., Chicago, Ill. This reel is so designed that it unwinds the stock at about the right speed for the punch press; but should the unwound loop become too large, it comes in contact with a roller and stops the motor. The motor starts again automatically as soon as the loop has been reduced to its normal operating size.

The side plates of the reel revolve, and therefore do not curl the stock. These plates can be adjusted sidewise by handles which operate the adjusting screws. The reel will take coils having an inside diameter of 16 inches, an outside diameter of 38 inches, a width of 30 inches and a weight of up to 3000 pounds. 96

Stamets Tapping Machine for Oil-Pipe Couplings

A machine for tapping oil-field pipe couplings, which has the upper structure supported by two ground cylindrical columns that serve as ways for the traveling head, has been brought out by William K. Stamets, Jenkins Arcade Bldg., Pittsburgh, Pa. The head of this machine has rapid traverse in both directions, and the feed for tapping is obtained by means of an accurately ground lead-screw having a coarse thread. The lead-screw is located directly in line with the spindle. The machine is provided with a free-floating chuck for holding the coupling to be tapped, the coupling having previously been accurately bored and faced.



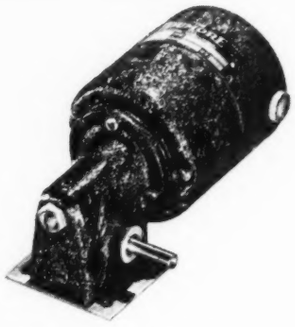
Stamets Pipe-coupling Tapping Machine

To obtain additional information on equipment described on this page, see lower part of page 562.

In chucking, a finished face of the coupling is located at right angles with the center line of the spindle by a surface plate. The chuck is then advanced by means of an air cylinder until the coupling is approximately in line with the tap. As the tap enters the work, the coupling is free to float into alignment with the tap. After one end of the coupling is tapped, the chuck recedes and the coupling is ejected and reversed in the chuck. After the coupling is chucked, the operation of the machine is automatic, including the tripping and resetting of the tap. 97

desired amount according to the amount of grinding necessary on each blade, thus reducing the grinding time and unnecessary loss of tungsten carbide.

This type of blade lock facilitates setting up or changing blades, since the blades are locked in place in pairs with an external clamp, requiring only a turn of an Allen wrench to either tighten or release the clamp. Other advantages include maximum heat conductivity through the provision of accurately fitted full-face blade seats and security of the blade lock without need for end-stops. 98



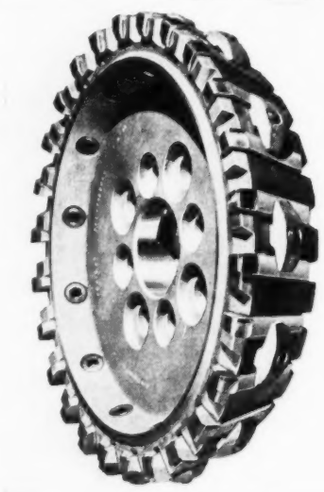
Dumore Fractional-horsepower Motor

Dumore Universal Motors with Reduction Gear Units

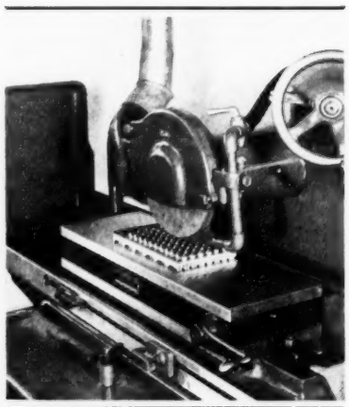
A line of universal fractional-horsepower motors with single reduction gear units having horsepower output ratings ranging from 1/92 to 1/38 horsepower and full load speeds from 83 to 929 revolutions per minute is the latest addition to the line made by the Dumore Co., Racine, Wis. The types HL and HVL motors of this line are identical, except that the former has a totally enclosed housing and thirty-minute rating, while the latter has a ventilated housing and will operate continuously at the rated output. 100

Ex-Cell-O Tungsten-Carbide Milling Cutters

With a view to lowering replacement blade costs on tungsten-carbide tipped milling cutters, the Ex-Cell-O Corporation, 1212 Oakman Blvd., Detroit, Mich., in cooperation with the Carboloy Company, Inc., has developed a new line of tungsten-carbide milling cutters. The Continental type "RC" blade lock is employed on these new cutters, in which taper blades fit into accurately tapered seats, the blade supports being integral with the cutter body. The blades can be adjusted individually any



Ex-Cell-O Removable-blade Milling Cutter



Brown & Sharpe Permanent-magnet Chuck with Adapter Plate for Small Parts

Brown & Sharpe Permanent-Magnet Chuck

A permanent-magnet chuck having a working surface 8 3/4 by 24 7/16 inches has been brought out to supplement the two smaller chucks of this type recently placed on the market by the Brown & Sharpe Mfg. Co., Providence, R. I. Like the two smaller models described in October, 1937, MACHINERY, page 157, this chuck requires no electric current, electrical connections, wires, or switches.

A new adapter plate has also been brought out for use with this chuck for holding pieces that are too small to be easily held on the regular surface of the chuck. This adapter plate is available in three sizes. 99

Adjustable-Alignment Drill Chuck for Screw Machines

An adjustable collet chuck especially adapted for holding drills and reamers in both hand and automatic screw machines, has been brought out by the Universal Engineering Co., Frankenmuth, Mich. Provision for adjusting the chuck to align the drill or reamer with the machine spindle, and thus compensate for any wear in the turret-slide, is an outstanding feature of this chuck. The chuck is provided with keys, as shown in the upper view of the illustration, so that the flanges can be set at right angles to the turret-slide, thus

To obtain additional information on equipment described on this page, see lower part of page 562.